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MALLORY LINE TWIN-SCREW PASSENGER AND FREIGHT STEAMSHIP SAN JACINTO.

Among the finest, and equalling if not surpassing the best steamships frequenting our Atlantic coast, will be found before the ushering in of the year 1904 the New York and Texas Steamship Company's steamship *San Jacinto,* designed, built, and equipped by the Delaware River Iron Shipbuilding and Engine Works, more familiarly known as Roach's Shipyard, at Chester, Pa. As is well known, this steamship company, C. H. Mallory and Company, agents, operates a line of steamers between New York and Galveston, Tex., touching at several intermediate points en route.

GENERAL FEATURES.

The *San Jacinto* is built to the rules and under survey of the U. S. Standard Steamship Owners', Builders', and Underwriters' Association, Ltd., with tested material, of the hurricane-deck class for coastwise service, A1 for twenty years, having single bottom, six water-tight and three non-water-tight bulkheads, with orlop deck forward to No. 2 bulkhead, which divides the fore hold, and having in common with the lower, main, and forecastle decks channel-section beams 10 by 3 1-2 by 3 1-2 inches, secured to alternate frames by gusset plates.

LAUNCHING THE TWIN-SCREW STEAMSHIP SAN JACINTO FROM ROACH'S SHIPYARD.

In the latest intended addition to this familiar line the public will appreciate a type of vessel very different from those now engaged in this trade. The *San Jacinto* is a twin-screw ship, and in this respect the pioneer of the Mallory Line; this feature they were loath to adopt when the builders first presented it for their consideration. Realizing, however, the difficulty of embodying large carrying capacity with high speed on limited draft of water, they were finally convinced of the necessity for accepting it.

On the contract draft this ship's coefficient is just under 70 per cent., which is readily appreciated as a trying proposition for high speed. On this draft the cargo-carrying capacity will be 2,500 tons and the coal capacity 1,250 tons in addition, or a dead weight of 3,750 tons.

The forward orlop deck is wood covered by spruce, 4 inches thick. The lower and main decks, extending all fore and aft, are completely steel covered and water-tight and without wood. The forecastle deck has 10-pound steel plates upon beams and covered with a 3 1-2-inch cypress deck plank. No. 2 hold is in the deep hold extending from ship's floors to lower deck. At the orlop-deck height the side stringer extends aft to after collision bulkhead. At this height, abaft the engine room, are cargo platforms covering tops of shaft tunnels and water tanks. Outside of tunnels at forward ends of same are cargo holds extending from the ship's floors to the lower deck, and near the after end of tunnels this cargo hold is between the two tunnels, while at the extreme after end is the large fresh-water tank of 100 tons capacity for make-up water for main-

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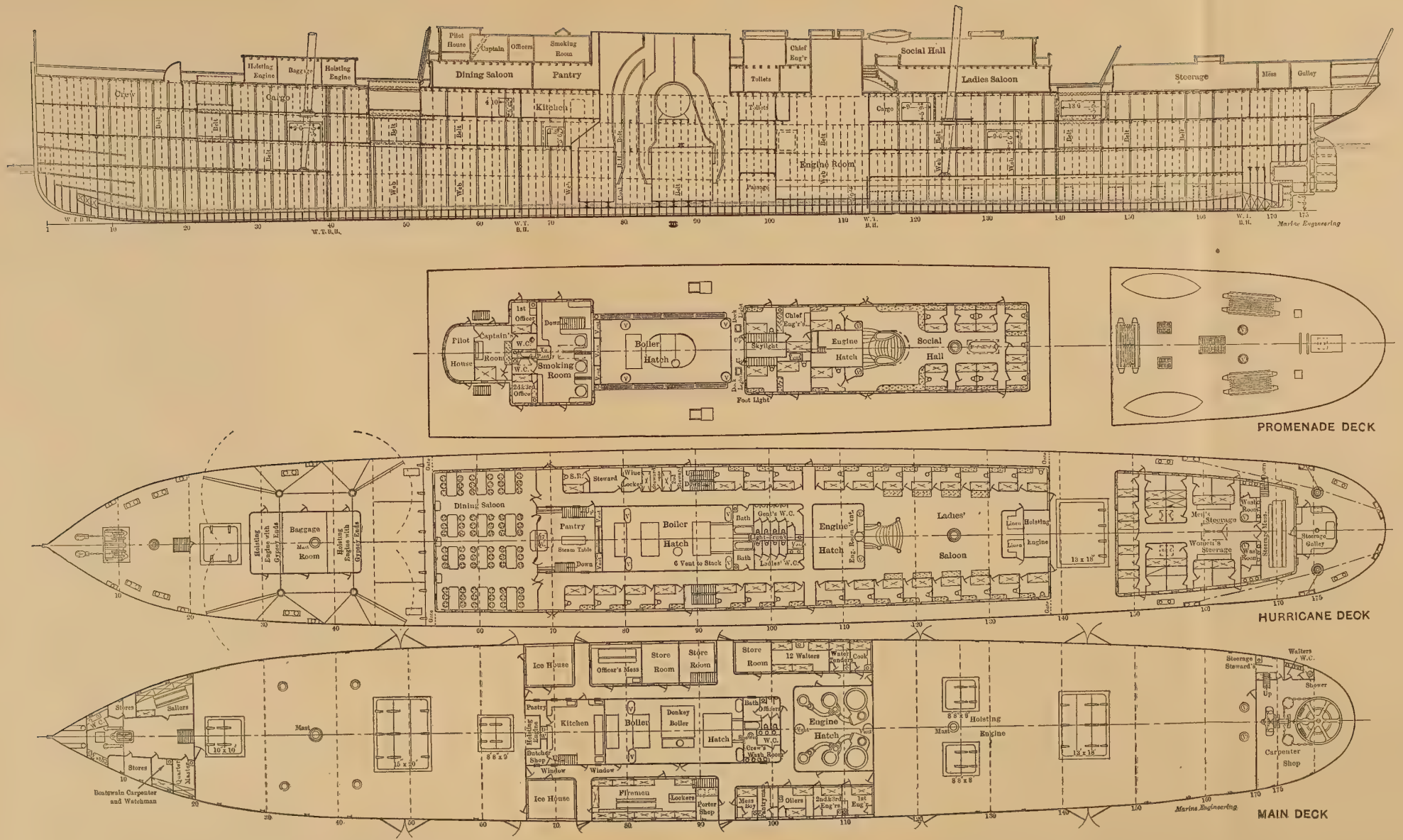


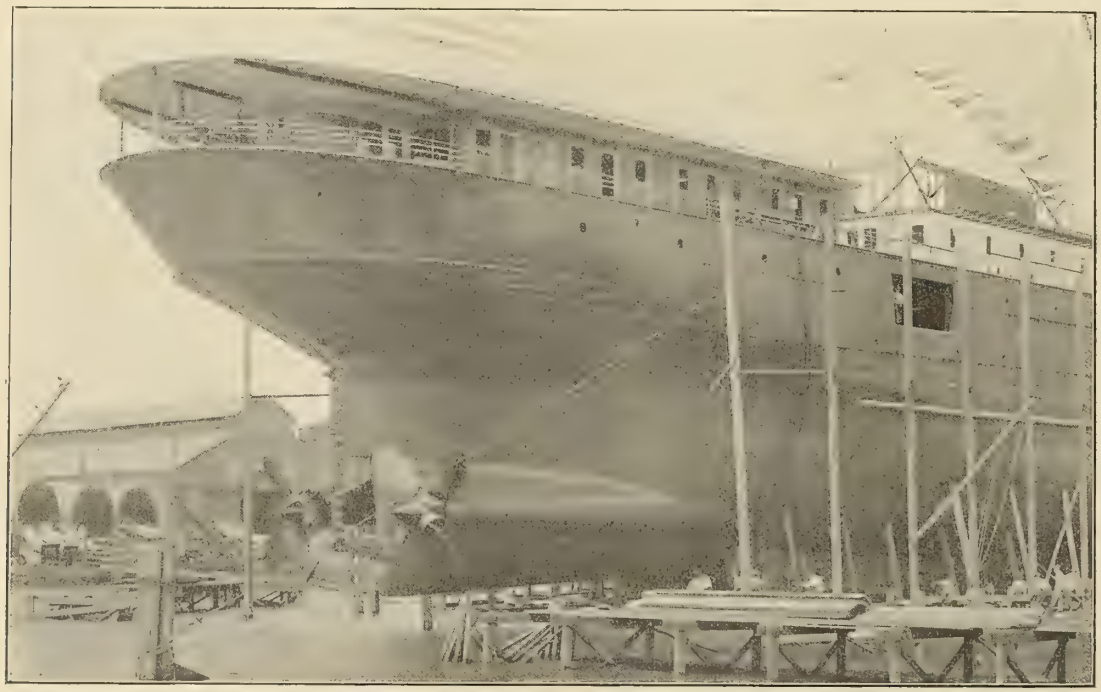
LONGITUDINAL ELEVATION AND DECK PLANS OF THE NEW TWIN-SCREW COASTING STEAMER SAN JACINTO, BUILT BY ROACH'S SHIPYARD FOR THE MALLORY LINE.

boiler use. This tank is so located that it utilizes a space that would otherwise be wasted or rendered expensive for cargo handling owing to the sharpness of the vessel at this point.

There are six over-all and three blind hatches. The cargo is handled through these blind hatches by means of cranes and Lidgerwood hoisting engines, 5 by 8-inch cylinders, the hatches of lower deck having wooden covers. Half-round iron is riveted to the under flanges of beams and carlins to prevent chafing of whips when handling the cargo. The main-deck hatches have high coverings and water-tight hinged steel covers, as have also the hurricane and forecastle decks; the coverings of main deck being flanged under beams and carlins to prevent chafing, etc.

GENERAL ARRANGEMENT, HURRICANE DECK.

The plan of the hurricane deck from stem to stern is as follows: First, a steel companionway, leading to crew's quarters and windlass engine in forecastle; next aft is No. 1 over-all hatch, 10 by 10 feet; continuing aft is the forward steel house, enclosing two Lidgerwood hoisting engines, one at each end; and in the center of the house is the baggage room, the foremast extending down through the same. On each side of this forward house are cargo posts, two being abreast of the forward end and two abreast of the after end, used for derricks to handle the cargo through Nos. 1 and 2 hatches. The forward derricks have a capacity of 8 tons and the after pair a capacity of 12 tons each, handled by the two hoisting engines in forward house

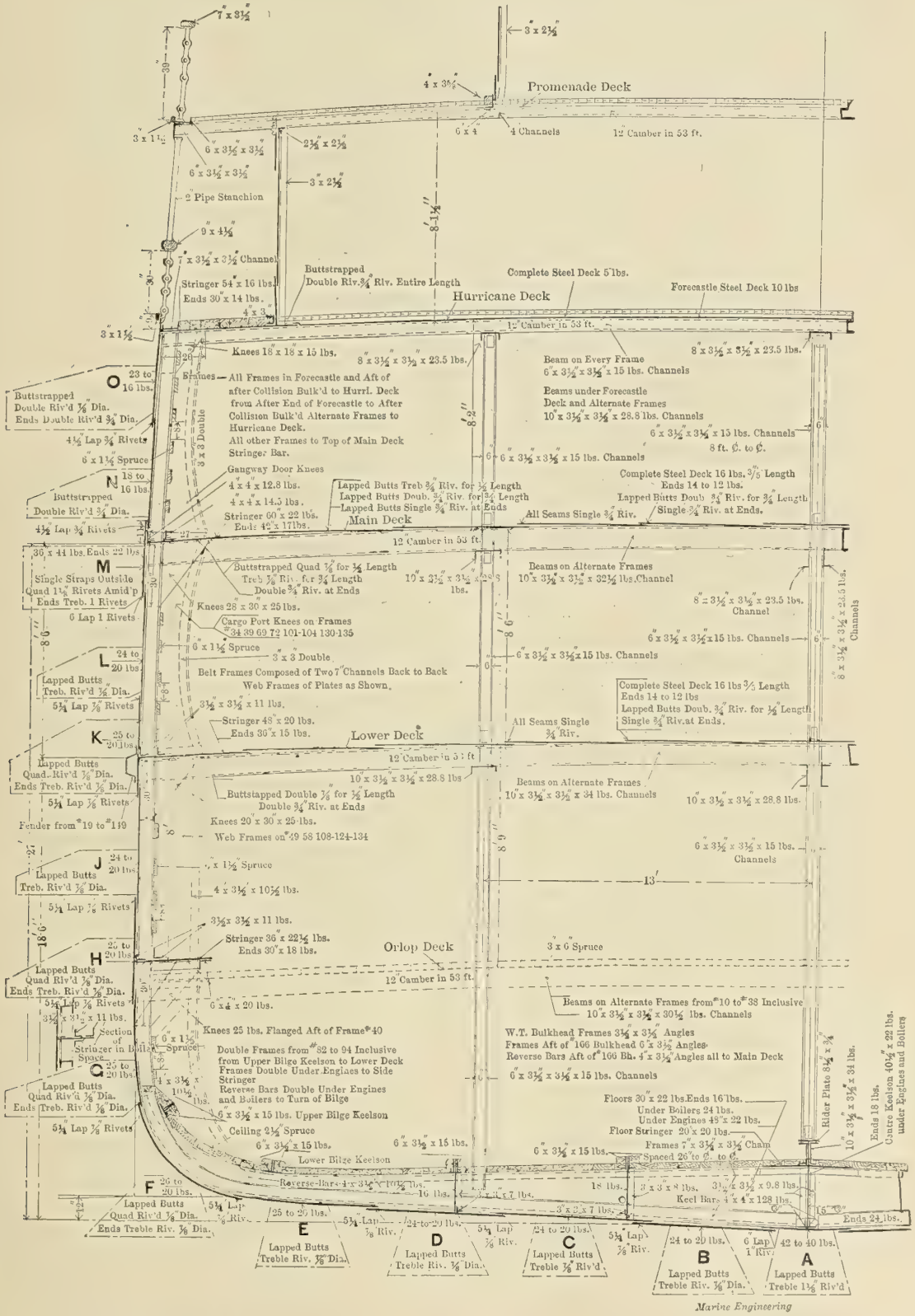


VIEW OF THE STERN OF THE SAN JACINTO JUST BEFORE LAUNCHING.

From No. 2 hatch the beams of hurricane deck are 6 by 3 by 3 inches, gusseted to alternate frames and clipped to hurricane deck, sheer strake between them, the alternate frames only extending to hurricane deck, the intermediate ones stopping at main-deck height from No. 2 hatch to within 30 feet of the stern; from this point around the stern and from stern to No. 2 hatch all frames extend to the hurricane deck. From No. 2 hatch aft, the hurricane deck is covered with 5-pound steel plates as a preventive against fire reaching the cabins, should such occur in upper cargo between decks, and on top of this is laid a cypress deck. The ship is rigged as a two-masted schooner, with steel masts, having four sails, awnings, weather cloths, etc., complete. On the after side of foremast a 30-ton derrick will be provided for handling heavy cargo through No. 2 over-all hatch. On the after side of mainmast two 12-ton derricks will be installed to handle cargo through No. 3 over-all hatch.

mentioned above; these engines are double drum, double cylinders, 8 by 8 inches, with winch heads on each end of drum shafts for extra hoisting, etc. No. 2 is what is termed a cut-down hatch, having hinged water-tight covers or shutters, which raise up aft and rest against the fore end of promenade deck. Abreast this hatch, side or gangway ports swing open fore and aft, permitting cargo handling over the main deck sheer strake, avoiding thereby the necessity of hoisting it to the height of the hurricane deck, which otherwise would be the case.

Next aft is the central steel house enclosing the first-class passenger accommodations and 225 feet in length. In the forward end of this house is the dining saloon, with round lights in front and drop-sash windows and blinds on the sides. Sliding doors on each side open into lobbies, from which the dining room is entered, and passageways and state rooms extend aft to a large and attractive cabin. All the inside facework, includ-


Promenade Deck
Hurricane Deck
Main Deck
Lower Deck
Orlop Deck
Complete Steel Deck 5 lbs.
Forecastle Steel Deck 10 lbs
12" Camber in 53 ft.
Beam on Every Frame
6" x 3½" x 3½" x 15 lbs. Channels
Beams under Forecastle Deck and Alternate Frames
10" x 3½" x 3⅛" x 28.8 lbs. Channels
8" x 3½" x 3½" x 23.5 lbs.
6" x 3½" x 3¼" x 15 lbs. Channels
8 ft. ℄ to ℄.
Complete Steel Deck 16 lbs. 3/5 Length
Ends 14 to 12 lbs.
Lapped Butts Doub. ¾" Riv. for ¾ Length
Single ¾" Riv. at Ends.
All Seams Single ¾" Riv.
Lapped Butts Treb ¾" Riv. for ½ Length
Lapped Butts Doub. ¾" Riv. for ¾ Length
Lapped Butts Single ¾" Riv. at Ends
Buttstrapped Double Riv. ¾" Riv. Entire Length
Stringer 54" x 16 lbs.
Ends 30" x 14 lbs.
7" x 3½" x 3½" Channel
2 Pipe Stanchion
9" x 4½"
6" x 3½" x 3½"
2½" x 2½"
3" x 2½"
4" x 3½"
3" x 1½"
6 x 4
4 Channels
12" Camber in 53 ft.
8'-1½"
8'-2"
Knees 18" x 18" x 15 lbs.
Frames — All Frames in Forecastle and Aft of after Collision Bulk'd to Hurrl. Deck from After End of Forecastle to After Collision Bulk'd Alternate Frames to Hurricane Deck.
All other Frames to Top of Main Deck
Stringer Bar.
Gangway Door Knees
4" x 4" x 12.8 lbs.
4" x 4" x 14.5 lbs.
Stringer 60" x 22 lbs.
Ends 42" x 17 lbs.
O 23 to 16 lbs.
N 18 to 16 lbs.
Buttstrapped Double Riv'd ⅞" Dia.
Ends Double Riv'd ¾" Dia.
4½" Lap ¾" Rivets
6" x 1¼" Spruce
3" x 3" Double
Buttstrapped Double Riv'd ¾" Dia.
4½" Lap ¾" Rivets
36" x 44 lbs. Ends 22 lbs.
M
Single Straps Outside Quad 1⅛" Rivets Amid'p
Ends Treb. 1 Rivets
6 Lap 1 Rivets
L 24 to 20 lbs.
Lapped Butts Treb. Riv'd ⅞ Dia.
5¼" Lap ⅞" Rivets
K 25 to 20 lbs.
Lapped Butts Quad. Riv'd ⅞" Dia.
Ends Treb. Riv'd ⅞" Dia.
5¼" Lap ⅞ Rivets
Fender from #19 to #119
J 24 to 20 lbs.
Lapped Butts Treb. Riv'd ⅞" Dia.
5¼ Lap ⅞ Rivets
H 25 to 20 lbs.
Lapped Butts Quad Riv'd ⅞" Dia.
Ends Treb. Riv'd ⅞" Dia.
5¼" Lap ⅞ Rivets
3½" x 3½" x 11 lbs.
Section of Stringer in Bilge Space
G 25 to 20 lbs.
Lapped Butts Quad Riv'd ⅞" Dia.
Ends Treb. Riv'd ⅞" Dia.
5¼" Lap ⅞" Rivets
F 25 to 20 lbs.
Lapped Butts Quad Riv'd ⅞" Dia.
Ends Treb. Riv. ⅞" Dia.
5¼" Lap ⅞" Riv.
E 25 to 20 lbs.
Lapped Butts Treble Riv. ⅞" Dia.
5¼" Lap ⅞" Riv.
D 24 to 20 lbs.
Lapped Butts Treble Riv. ⅞" Dia.
5¼" Lap ⅞ Riv.
C 24 to 20 lbs.
Lapped Butts Treble ⅞" Riv'd.
5¼" Lap ⅞" Riv.
B 24 to 20 lbs.
Lapped Butts Treble Riv. ⅞" Dia.
6" Lap 1" Riv.
A 42 to 40 lbs.
Lapped Butts Treble 1⅛" Riv'd
Buttstrapped Quad ⅞" for ½ Length
Treb ⅞" Riv. for ¾ Length
Double ¾" Riv. at Ends
Knees 28" x 30" x 25 lbs.
Cargo Port Knees on Frames
#34 39 69 72 101-104 130-135
6" x 1¼" Spruce
Belt Frames Composed of Two 7" Channels Back to Back
Web Frames of Plates as Shown.
3½" x 3½" x 11 lbs.
Stringer 48" x 20 lbs.
Ends 36" x 15 lbs.
10" x 3½" x 3½" x 28.8 lbs
Buttstrapped Double ⅞" for ½" Length
Double ¾" Riv. at Ends
Knees 20" x 30" x 25 lbs.
Web Frames on #29 58 108-124-134
4" x 3½" x 10½ lbs.
Stringer 36" x 22½ lbs.
Ends 30" x 18 lbs.
6" x 4" x 20 lbs.
Knees 25 lbs. Flanged Aft of Frame #40
6" x 1½" Spruce
Double Frames from #32 to 94 Inclusive from Upper Bilge Keelson to Lower Deck
Frames Double Under Engines to Side Stringer
Reverse Bars Double Under Engines and Boilers to Turn of Bilge
6" x 3½" x 15 lbs. Upper Bilge Keelson
Ceiling 2½" Spruce
6" x 3½" x 15 lbs.
Lower Bilge Keelson
Reverse Bars 4" x 3½" x 10½ lbs.
16 lbs.
Beams on Alternate Frames
10" x 3½" x 3⅛" x 32½ lbs. Channel
Beams on Alternate Frames
10" x 3½" x 3½" x 34 lbs. Channels
Beams on Alternate Frames from #10 to #38 Inclusive
10" x 3½" x 3⅝" x 30½ lbs. Channels
W.T. Bulkhead Frames 3½" x 3½" Angles
Frames Aft of #66 Bulkhead 6" x 3½" Angles.
Reverse Bars Aft of #66 Bh. 4" x 3¼" Angles all to Main Deck
6" x 3½" x 3½" x 15 lbs. Channels
Floors 30" x 22 lbs. Ends 16 lbs.
Under Boilers 24 lbs.
Under Engines 48" x 22 lbs.
Floor Stringer 20" x 20 lbs.
Frames 7" x 3½" x 3½" Chain
Spaced 26" to ℄ to ℄
3" x 6" Spruce
13'
8'-9"
8'-2"
8'-6"
8'-8"
8'-10"
3" x 3" x 8 lbs.
3½" x 3½" x 9.8 lbs.
Keel Bars 4" x 4" x 128 lbs.
Rider Plate 8¾" x ¾
10" x 3½" x 9½" x 34 lbs.
Ends 18 lbs.
Centre Keelson 40¼" x 22 lbs. under Engines and Boilers
Ends 24 lbs.
Marine Engineering

MIDSHIP SECTION OF THE SAN JACINTO, BUILT FOR THE NEW YORK AND TEXAS STEAMSHIP COMPANY (MALLORY LINE) AT ROACH'S SHIPYARD.

ing the dining saloon, is finished in highly-polished, handsomely-grained quartered oak attractively paneled. In the center of the ship, and immediately connecting with the dining saloon at after end, is the pantry, equipped with all the necessary equipment looking to the perfect service of a first-class passenger ship, being fitted with dressers, plate racks, sinks, pumps, ice boxes, refrigerators, steam tables, plate warmers, etc., complete in every particular. The pantry is situated directly over the kitchen, having access thereto by means of stairs and dumbwaiter, is well lighted and ventilated by skylights and air shafts, as is also the kitchen below, and the service from kitchen to pantry and to dining saloon is very direct and convenient. As stated before, passengers leaving the dining saloon pass into the lobbies on either side and down the inside passageway to ladies' cabin or to their state rooms. From the starboard passageway access is had to the smoking room above by a stairway recessed into the pantry. All the first-class passenger state rooms on this deck are entered from the inside passageway or ladies' cabin. The rooms are large, light, and airy, and each is fitted with drop-sash window and blinds, with white-enamel folding berths, porcelain wash basin and cast-iron receiver, tumbler and towel rack, mirror, etc., electric light, steam heat, call bell, and all modern conveniences, inviting the traveler to rest and comfort in either winter or summer.

The ladies' cabin is well lighted and ventilated; large prismatic glass lenses set in the deck above light up the passageways by day, while beautifully-arranged electric lights brighten them and the saloons by night. The mainmast extends down through the center of the ladies' cabin and is cased with polished quartered oak. A large well hole encircling the grand stairway at forward end of cabin, also of quartered oak, leads to the social hall above; while a large and handsome mirror at second landing gives a fine effect to the whole apartments, which are handsomely furnished with fixed couches and chairs.

Midway of the first cabin, with cross passage connecting the side passageways, and between the boiler and engine enclosures, are the first-class toilet rooms. The women's, on the port side, has handsomely tiled floors and tiled wainscoting, flushing closets, marble wash stand, and a bath room with porcelain tub and shower baths. All the quarters are well lighted and aired by an air shaft leading up through the houses above to a skylight. On the starboard side are the men's toilets, similarly arranged in regard to baths, wash basins, light, air, etc. Connected with both closets also are air ducts leading into the outer casing of main smokestack, which will supply an induced exhaust draft that will insure pure air for these quarters. The plumbing here, as well as elsewhere throughout the ship, is of the best, and is supplied and installed by Mr. H. C. Calkin, Jr., New York, N. Y.

PROMENADE DECK.

The social hall, on the promenade deck, is finished in white maple beautifully paneled and polished, the grain producing a fine effect. The few passenger rooms within this hall are provided with all the comforts of those below, being equally pleasing and inviting. Over the grand stairway a handsome dome supplies light for the cabin; and aft of the mainmast, which passes down through the center of these quarters, is a skylight, with a well-hole through social-hall deck to give light to the after end of the ladies' cabin. From the social hall large sliding doors permit the passenger to reach the promenade deck and fresh air.

From the forward end of dining saloon to the after end of ladies' cabin the outside deck space makes a fine promenade, 225 feet in length, for the use of first-class cabin passengers in fair-weather days. Aft of the first cabin is No. 3 over-all hatch, 13 by 18 feet, the cargo from which is worked, as before mentioned, by two cargo derricks, with engines enclosed in the after end of first-cabin steel house. Aft this No. 3 hatch is a steel house, the deck of which extends over to the side of the ship for shelter; here are the second cabin or steerage passengers' quarters, finished in pine neatly paneled. This house is divided centrally fore and aft for the men and women; the state rooms are fitted with three high iron-pipe berths, making a total capacity of fifty-one; separate wash rooms and water closets are provided. A common mess room, with steam kitchen attached, directly aft, provides for the necessities of life during the voyage. These quarters are exceptionally well lighted, aired, and equipped with respect to comfort and conveniences.

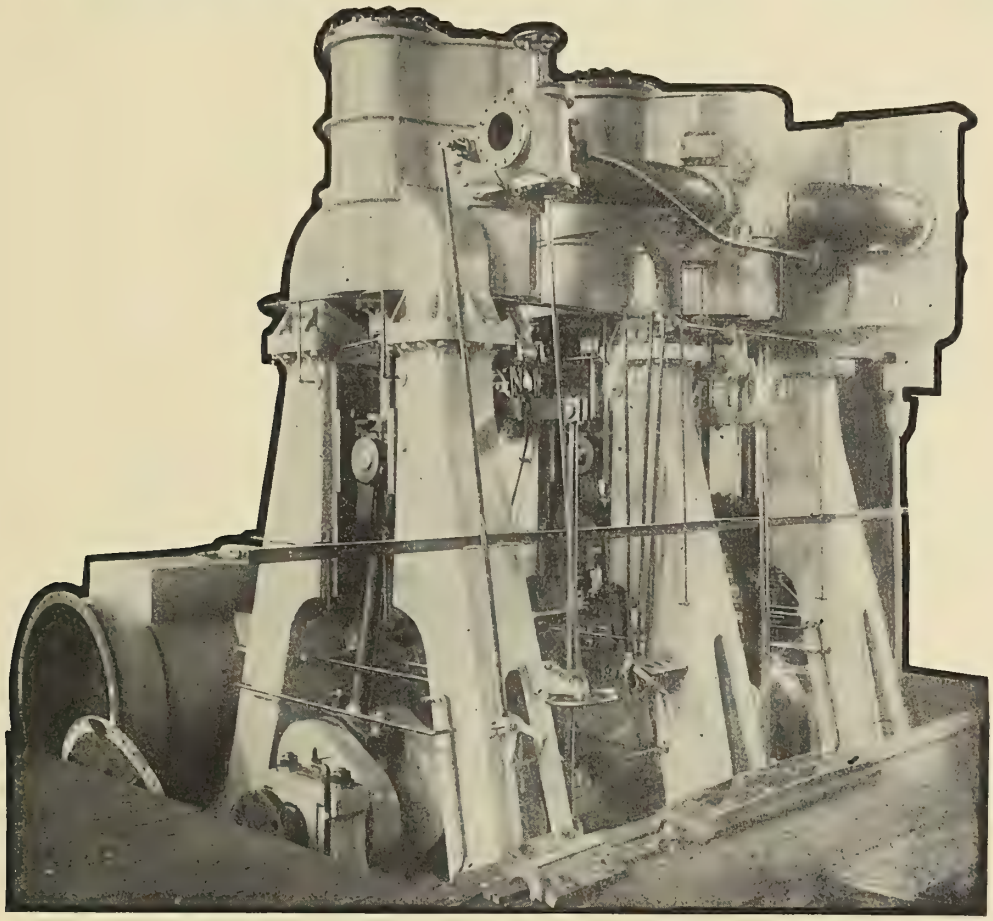
On the forward end of promenade deck and over the dining saloon is the steel pilot house, finished inside with sycamore and equipped with all instruments necessary for the proper navigation of the ship. Above the pilot house is the bridge, upon which is located a steering wheel and a 1,000-candle-power searchlight, operated from within the pilot house as well as on the bridge. Abaft the pilot house is the captain's room, finished in polished sycamore, and well furnished with the conveniences of bath, wash room, and water closet. Aft of the captain's room the steel house widens to accommodate the first officer on one side, and the second and third officers' quarters on the other. These rooms are finished in quartered oak and made as comfortable and homelike as possible.

Aft of the officers' quarters is the smoking room, with stairway, as before mentioned, leading below. It is handsomely finished in paneled hazel richly polished, and is every way attractive and convenient, supplied with seats and chairs tastefully upholstered, card tables, etc. A toilet room is placed at forward end, abreast of the captain's bath room. All these rooms are well lighted and ventilated with domes, windows, and skylights; a skylight passing down through a trunk in forward end of smoking room permits light and air reaching the pantry and kitchen below.

Aft of the smoking room is the fidley or smokestack enclosure; aft of this is the social-hall steel house before mentioned, in the end of which is the chief engineer's room, with inside door leading direct to the engines. The chief engineer lacks nothing for convenience and comfort, and is taken care of in a manner at once appreciated. There are three outside passenger rooms in the fore end of this social hall, in the center of which, at the forward end, are stairs leading to the boats placed on the deck above, which extends over to the side of the ship, making a permanent shade deck. There are four large boats, 23 feet 3 inches long, on

this shade deck, operated with the Mallory boat davit gear. On the after or steerage house are two more boats of this size and three liferafts. This ship is amply equipped with safety devices and passenger security against possible accident, in excess of all government rules and regulations.

In outside appearance the *San Jacinto* will resemble somewhat the *Denver*, of the same line, but is much larger and more powerful. Rigged, as before mentioned, as a two-masted schooner, with proportionally distributed deck houses, etc., she will make a striking picture as she sails on her maiden trip from New York about December 15 next. Her principal dimensions are: length over all, 404 feet; length on the water line, 382 feet; beam, molded, 53 feet; and depth, molded at half length of hurricane deck, 35 feet.



ONE OF THE TWO 3-CYLINDER, TRIPLE-EXPANSION ENGINES FOR THE SAN JACINTO.

HULL CONSTRUCTION.

In hull construction the most striking feature, perhaps, from an owner's point of view, is the scarcity of stanchions; stiffness and strength being secured by the suspension-girder system or ridge-bar connection under beams, which consists of channel-section material. The center girder is double, with webs vertical and upper flanges securely riveted to the under side of the channel beams of the several decks. These channel girders are back to back, but far enough apart to permit a row of double channel-section stanchions being riveted between them, the stanchions also being riveted to the beams; these center stanchions are spread 8 feet apart. At quarter breadth are fore-and-aft girders, with webs riveted to the under side of deck beams, and with double channel-section stanchions securely riveted to their under side, spaced 16 feet centers, or double the distance of the center ones. This construction is adopted throughout the ship; in the holds as well as in the between-decks wood is filled in between the flanges of all stanchions, to prevent chafing of freight, etc. This ship is built on the channel system, channels being used wherever possible and desirable. The frames are 7 by 3 1-2 by 3 1-2-inch channels, in one piece from keel to hurricane deck at ends and to main deck and hurricane amidships alternately, being spread 26 inches apart. Beams of channel section are elsewhere described. In other respects the construction is similar to all the coastwise steamers.

MAIN DECK.

On the main deck, beginning forward on the starboard side, is the crew's wash room and water closet; the crew's quarters, or forecastle, being fitted with iron-pipe berths.

The windlass engine, having double cylinders 12 inches in diameter by 12 inches stroke, is located on the main deck; while the windlass is on the hurricane deck, and directly aft on the hurricane deck is the forward

capstan, geared from the windlass engine. There are two bower anchors (the Baldt stockless type) and 270 fathoms of 2 1-4-inch chain cable handled with this windlass and gear, which is of the Hyde Windlass Company manufacture. On the port side, main deck, are the store rooms, boatswain's, carpenter's and watchman's, also quartermaster's rooms.

The forecastle is separated from the upper between-deck freight space directly aft by a steel bulkhead. Aft this freight space and forward of boiler enclosure on main deck is the kitchen; central of the ship, and on each side of the kitchen, with passageway between, are two ice houses having a capacity of 20 tons each; aft the ice houses are the firemen's quarters, porter shop, water tenders', oilers', and first, second, and third engineers' rooms, on the port side; while on the starboard side are the mess room for officers, store rooms, waiters' quarters, and cooks' rooms, all comfortably located, equipped, and lighted. Toilet rooms for the crew and petty officers are amidships, between the boiler and engine enclosures, and consist of wash rooms, bath tubs, and shower baths complete, all well lighted and ventilated through an air shaft leading to top of houses. The steel deck throughout the midship quarters will be covered with plastic cement.

Abaft the engine room and midship quarters is the after upper between-deck freight space; at the after end of which, enclosed by a steel bulkhead, is a powerful steering gear governed and controlled by a massive Sickles steering engine, the same pattern as has been built for years at the Roach works. The engine is located just forward of the immense steering wheel on rudder stock, and is connected direct therewith by heavy tiller chains which hug the steering wheel in separate grooves. The rigidity of the connection with the rudder is relieved by means of strong springs attached to the tiller, which is keyed to the rudder stock. These springs take care of any jar that would otherwise be thrown directly upon the engine and its connecting gear whenever the rudder is buffeted by an angry sea. The tiller chains go directly to the drum of the steering engine through large quarter sheaves strongly secured to the main deck. The operating of the steering engine valve is had through a line of flexible shafting leading forward through freight space and up to the pilot house and bridge deck, and is in perfect control at all times. The rudder stock is extended up through the hurricane deck, through the steam kitchen for steerage passengers, to the deck above, where is located a large right- and left-hand screw gear controlled by three large hand-steering wheels, which constitute the inner quarry steering gear. There is also in addition a spare tiller below, with relieving tackle, to be used in case of accident to the main gear. There are also rudder pendants provided on the outside of the ship for immediate use, should it be necessary. The tiller, which is keyed to the rudder stock, has a large friction gear attached, by which it is possible to catch and secure the rudder in any position, should anything happen to the tiller chains. This whole steering arrangement is strong and substantially equipped, and, while ponderous in weight and strength, can be easily controlled.

ENGINES.

The propelling machinery consists of two sets of triple-expansion engines having cylinders 27 1-2, 44 1-2, and 70 inches in diameter by 42 inches stroke, turning twin propellers with right- and left-hand pitches, the tops of which turn outboard. The cranks are placed at equal angles. All the valves are of the piston variety and actuated by Marshall valve motion. Liners are fitted in the high and intermediate cylinders. The bed plates are of strong box form, the cylinder of each engine being supported upon two wide-spreading cast-iron columns resting upon two large flanged brackets of the bed plates; thus there are six columns to each engine. The cylinders are not tied together, having copper receiver pipes connecting the steam passages, but at the back and close up to the top flanges of the columns cast-iron bridges or ties are fitted as the means of securing the cylinders.

The cast-iron plate condensers are separated from the engines, being round in form and secured to large brackets cast on the bed plates. They have 3-4-inch brass tubes packed with screw ferrules, the cooling surface of each condenser being about 5,000 square feet. Pipes for boiling out and pumps for washing these condensers are supplied. The air pumps are driven from the low-pressure crossheads and have two bilge pumps at their sides attached to each. The air pumps are 24 inches in diameter and 18 inches stroke. Each main engine has its own circulating pump, which is centrifugal in its action and connected by means of cross pipes and valves with the condensers, giving each pump separate condensers, or either or both, as the engineer or conditions in the engine room may dictate; the feed pumps, sanitary pumps, bilge pumps, and fire pumps being ample in size and capacity.

The crank shafts are of the built-up type, in three pieces, and interchangeable. Crank pins are 13 1-4 inches in diameter by 14 inches long, the sequence of the cranks being: high-pressure, intermediate-pressure, and low-pressure. The thrust shafts are 13 1-4 inches in diameter, having couplings forged on and ten collars. The collars are 20 inches by 2 inches thick, working in oil bath in the horseshoe thrust, with bearing at each end of thrust-collar rings resting upon plumber blocks at each end of thrust-block casting. The intermediate or line shafting is 12 7-8 inches in diameter, with solid couplings forged on each end; each piece of line shafting being carried on two pillow-block bearings, the diameter of shaft bearing being 13 1-4 inches. The tail or propeller shafts are 13 1-4 inches in diameter, having a solid coupling forged on inner end; while the outer end is covered with a gun-metal sleeve the full length of the bushings or bearings within the stern pipes, said bearings consisting of end-grain lignum vitæ. The after end of the shaft line, including the stern bushings, is enclosed within the hull of the ship upon the patents of Captain Lundborg, for which purpose the builder took out a license.

All the shaft couplings have cross keys and parallel coupling bolts, and turn upon white-metal-lined cast-iron boxes. This metal is used throughout the machinery and gives entire satisfaction. The shafting and all principal forgings were furnished by the Bethlehem

Steel Company and are of fluid-compressed steel throughout.

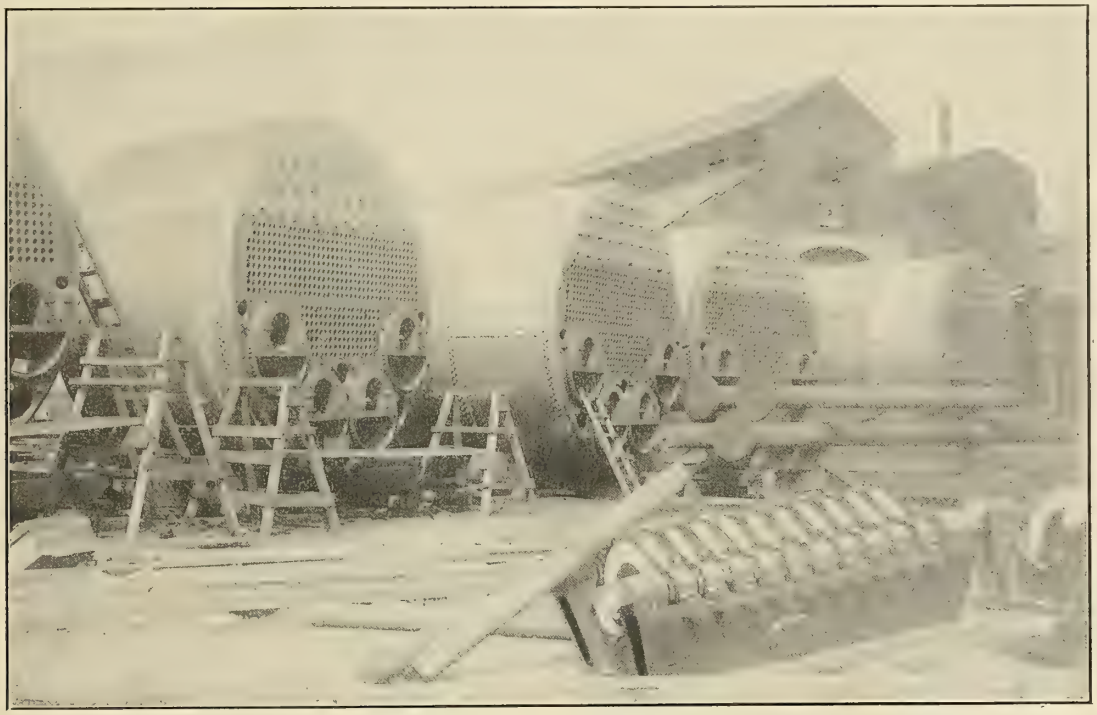
All the working parts of the engines, piston rods, connecting rods, valve stems and rods, etc., are in size and stiffness beyond the figured stresses likely to be put upon them, wearing surfaces being ample in a liberal degree. The piston and valve-stem stuffing boxes are fitted throughout with the latest and most improved United States metallic packings. Reversing engine of the ram floating-lever type, 8 inches diameter with a stroke of 13 1-2 inches, and taking steam from main and auxiliary steam line, gives the engineer perfect control of his engine. The main throttle valve, which is of the double-ported, balanced-valve type, has between it and the high-pressure valve chest a butterfly valve, the handle of which extends down to the starting platform, giving the engineer on watch full control, enabling him to check racing of the propellers when the ship's stern is thrown partially out of the sea by the waves.

A steam turning gear, located centrally in after end of engine room, having link motion, with double cylinders 8 inches diameter by 10 inches stroke, geared to a pinch wheel on the after coupling of each crank shaft, is controlled by means of a hand-gear attachment to turning-engine flywheel.

A complete water service of brass pipe is fitted around the main engines and through the shaft tunnels. Oil lubrication is amply provided for all the principal working parts, siphon and approved sight-feed lubricators being freely used. Oil pumps are installed to collect the waste oil from the various pockets about the machinery and deliver into an oil-pumping tank for economical reasons.

A feed heater of the Wheeler type is fitted in the discharge line to the boiler, the steam not used by heater going to the low-pressure receiver, and so on to the condenser; both main feed pumps pump through this heater as well as to the main boilers direct. An auxiliary condenser and pump, amply large and sufficient in capacity for the purposes intended, are installed. All pumps are of the Blake type, of the following dimensions:

Feed pump, two.....12, 8 1-2 by 12 in. duplex
Fire pump, one.....12, 8 1-2 by 10 in.
Donkey-boiler feed, one.....6, 4 by 6 in.
Salt-water sanitary, one.....6, 5 3-4 by 6 in.
Fore and aft peak tanks, two.....4 1-2, 4 by 4 in.



A GROUP OF BOILERS AT ROACH'S SHIPYARD FOR THE NEW TWIN-SCREW STEAMSHIP SAN JACINTO.

BOILERS.

The boiler power consists of three double- and two single-end Scotch boilers, built for a working pressure of 180 pounds per square inch, all of 16 feet diameter, the double-end boilers being 18 feet 6 inches long and the single-end 10 feet 5 inches. Each single-end boiler has four removable furnaces, supplied by John Brown and Company, of England, 40 inches inside diameter, and having common back connections. The double-end boilers are fitted with eight such furnaces. There are 470 3-inch tubes, the proper number of them being stay tubes. On a 6-foot bar the total grate surface is 640 square feet, the total heating surface being 22,400 square feet. The three double-end boilers are placed abreast of each other, separated from the engine room by a coal bunker. The two single boilers are amidships forward of the double boilers, thus giving two athwartship fire rooms, the after fire room taking care of twelve furnaces and the forward fire room providing for twenty. Coal is conveniently stowed in several lower

bunkers, and directly above in the lower between-decks, descending without much labor to the fire rooms. The total capacity of the bunkers is 1,250 tons. The between-deck portion is used on the run South, leaving the space available for cargo on the return voyage, the lower bunker coal being ample for the return trip. The main boilers, also the donkey boiler, built by the New York Shipbuilding Company, of Camden, N. J., are exceptionally fine pieces of boiler maker's handiwork. The smoke and heated gases from main and donkey boilers escape through the breeching into the uptake, which delivers them into a huge stack divided into three compartments or flues, the after ends of the double boilers having their gases delivered into a common compartment of the stack, and in the same manner the fore ends of these boilers deliver gases into a common chamber, as do also the two single-end boilers; the donkey boiler has a stack to itself within the main stack. The main stack is double and elliptical in form, 15 feet fore-and-aft diameter by 11 feet athwartships, and with a total height above lower furnaces of 100 feet. The escape pipe mounting to the top of the stack is 14 inches diameter.

All necessary mountings and fittings for the boilers are supplied, including Ashton pop, spring-loaded, easing-gear safety valve, twin connected on the valve chests of the boilers (the double-end boilers having safety valves at each end); injector connections, main stop valves, surface and bottom blow valves, drains, gauges, zinc plates; Korting ejectors arranged for water circulation when getting up steam; water columns and gauge glasses having electric lights fitted behind them to show the water level from all parts of the fire rooms.

Two ash ejectors, one in each fire room, are installed for ready use in discharging ashes; in addition to which are steam hoists delivering ashes to the upper platforms, from which they are dumped overboard. For proper and sufficient supply of fresh air into the fire rooms there are four extremely large ventilators, the hoods of which are under the control of those below, and will either deliver air into the fire rooms or exhaust it. Large ventilators are also supplied for the engine room. An ample supply of tools, fittings, spare parts, etc., for both engine and boilers, will give security to this entire plant.

In the aggregation of so much boiler and engine power within a very limited space accorded to them, the designers have certainly had regard to the owners' most important and desirable acquisition, that of economy of space for their propelling machinery; for, occupying as it does the very heart of the ship, a wasteful expenditure of space here robs the owner of the very thing for which he builds his ship—the storage of large cargoes, whereby he hopes to receive a profitable return for his outlay of money and energy. In the present instance no complaint of this character can be laid at the door of the designers; for while ample space is provided for every necessary thing and all parts of machinery are accessible, yet not a foot of space is wasted, nor is there a corner or pocket where good light and ample fresh air are not to be found.

This ship and her propelling power throughout will be complete and up to date in every particular, and every one having to do with the *San Jacinto*, whether furnishing material or supplying labor, will be proud of the fact that from keel to trunks she equals any coastwise steamer afloat.

Telegraph and call bells, consisting of engine telegraph, double-faced transmitters on each end of bridge, in pilot house, and on each side of ship aft, connected with indicators in engine room, etc., give the captain perfect control of his ship at all times. Docking, steering, and rudder-indicator telegraph and the like add to the security. Speaking tubes to all important points keep the captain and engineer in perfect knowledge of what is transpiring within and without. There are calls to forecastle, crow's nest on foremast, chief engineer's room, engine room, fire rooms, captain's room and pilot house, mess rooms and kitchen, windlass, etc., and electric calls in all state rooms enable the passengers to have their many wants attended to at once. The system throughout was furnished and installed by Messrs. Charles Cory and Son.

The electric-lighting system, which is very complete and most artistically arranged in the cabins, goes a long way in making up an agreeable, comfortable, and pleasing ship in these days. Current is furnished by two 20 Kw. multipolar marine-type generating sets, being in duplicate; that is, all wiring being common to both machines, which are of the General Electric

NAME—San Jacinto. NATIONALITY—American. TYPE—Coaster, passenger, and freight steamer.
LAUNCHED—1902. BUILDER—Roach's Shipyard. OWNER—New York and Texas Steamship Co.

Length over all	404 ft. 0 ins.	Shafting, diam. propeller	13 1-4 ins.
" between perps	379 " 2 "	Condensers	two, cast-iron shells
" on water line	382 " 0 "	Cooling surf., each	5,000 sq. ft.
Beam, molded	53 " 0 "	Tubes, brass, diam	3-4 in.
Depth, " main deck	27 " 0 "	Air pump	direct-connected
" " hurricane deck	35 " 0 "	Size	24 ins. diam. by 18 ins.
Draft, load	19 " 0 "	**Propellers:** Number of blades, each	4
Displacement, load draft	7,600 tons	manganese bronze blades and cast-steel hubs.	
Dead-weight carrying capacity	3 750 "	Diam	15 ft.
Block coef	.70	Pitch	20 "
Speed, sea	17 knots	Area, each wheel	76 sq. ft.
Engines: Number	2	**Boilers:** Number	3 double-end, 2 single-end
I. H. P., designed sea	6,500	Length	18 ft. 6 ins., 10 ft. 5 ins.
R. P. M., "	110	Diam	16 ft.
M. E. P., reduced	36 2 lbs.	Pressure	180 lbs.
Type	3-cylinder, triple	**Furnaces:** Number each	8, 4
Cylinder diams	27 1-2, 44 1-2, 70 ins.	Diam., inside	40 ins.
Stroke	42 "	Length of grate	6 ft.
Valves	piston, all cylinder	G. S. total	640 sq. ft.
" diam	12, 18, 30 ins.	Tubes, diam	3 ins.
Valve gear	Marshall	Length between tube sheets	6 ft. 10 ins.
Piston rods, diam	6 3-4 ins.	Number	908, 470
Crank pins, "	13 1-4 "	H. S. total	22,400
Shafting, diam. crank	13 1-4 "	H. S. ÷ G. S	35.0
" thrust,	20 ins. and 13 1-4 "	I. H. P. (designed) ÷ G. S	10.2
" line	12 7-8 "	H. S. ÷ I. H. P. (designed)	3.45
		Admiralty coef.	291.

manufacture. The electrical fixtures, the design and handiwork of Jas. Barre and Company, will be the equal of anything in existence to-day. Besides the electric lighting will be provided an auxiliary oil lamp and candle effect. Electric fans will make the dining saloon pleasant and agreeable on sultry days, and other equally pleasing effects will be found throughout the whole of the first-class passenger quarters. Cargo spaces are lighted with electric clusters, etc., and the running or ship's lights are fitted for both electricity and oil. A powerful searchlight, elsewhere mentioned, is located on bridge.

This ship is fitted for 80 first-class passengers and 51 second-class or steerage passengers. She is expected to exceed her contract requirements, as do the Roach-built ships generally.

Measure of Speeds of Ships at Sea.*

NOTE BY E. GUYON.

The problem of the measure of the present high speeds of ships has not yet received satisfactory solution. The use of the ancient type of chip log is no longer practicable for speeds beyond 14 or 15 knots, and the so-called patent logs with propeller, which are towed by the ship, involve several undesirable features, of which one of the most serious is the frequent danger of loss. As to logs based on the principle of Pitot's tube, it has not yet been practicable to devise one which can be considered entirely satisfactory.

On nearly all ships which are propelled by steam alone the speed is commonly estimated from the revolutions of the engine. This method has the disadvantage of supposing known the advance per revolution of the shaft, and this advance varies with various circumstances, regarding which it is not possible to always appreciate in advance, the influence. But this method is so simple and practicable and is so well grounded in practice that it may be fairly considered as the most satisfactory, provided that it could be relieved of the single disadvantage, as mentioned above, by the provision on each ship of an instrument permitting the measurement of the advance per revolution as often as its value might appear uncertain.

This requirement may be fulfilled by an instrument based on the principle of some one of the logs mentioned above, since it would be sufficient for all purposes to measure simultaneously the speed of the ship and the revolutions of the engine, or, in other words, the number of revolutions of the propeller and the space traversed by the ship in the same time.

The principle to which I have thought best to give the preference is that of the old and familiar chip log. It is in fact the one which gives the most simple and practicable arrangements, and it has the further advantage of giving absolute results; while patent logs with a small propeller towed behind the ship always require a standardization which may be modified by the slightest deformation. It was necessary, however, while preserving the principle, to modify the arrangements of the chip log in such manner as to relieve it of the disadvantages which render its practical use far from satisfactory.

The few square inches of the chip of this log give evidently too small an area to offer the necessary resistance to the log line. This restricted area seems to be imposed by the necessity of hauling in the log after each measurement. In order to avoid this serious inconvenience, the line has been replaced by a cord of low price and of known length, which is abandoned to the sea at each measurement. There is in consequence no further limit to the dimensions of the chip, except such as may be imposed by considerations of expense, or of the complication of necessary arrangements. These are, moreover, greatly decreased by the fact that in the method under consideration it is no longer necessary to throw the log every hour, as formerly, but only so frequently as new circumstances may arise susceptible of modifying the advance per revolution.

The chip of the log is replaced by a bag of cotton cloth attached to a ring of reed of about 16 inches diameter, and into which is thrown a handful of sand in order to prevent its being readily carried by the wind. This bag, from the mass of water which it contains, as well as from its size, presents sufficient resistance to constitute a very satisfactory fixed point.

The old method of reeling the line on a drum was also no longer to be considered as a possibility. The very considerable circumferential velocities which would now be required (25 feet per second for 15 knots and 33 feet per second for 20 knots) would inevitably break the line. For this reason the line is rolled in balls of 100 meters (328 feet) similar to those made for the trade, and each ball is enclosed in a compartment of a case, from which it escapes without resistance and without ever becoming entangled. Four such balls are employed, the first serving simply to allow the bag to float backward to a sufficient distance to remove it from the effect of the wake. By means of simple electrical arrangements, each of the other three inscribes on a band of paper, similar to that in a Morse recorder, the period required for unrolling. On the same band, and parallel with the indications of the log, the revolutions of the engine are similarly inscribed, so that when the operation is terminated the officer of the watch may readily count the revolutions during the unrolling of the three balls of 100 meters (328 feet) each.

The register is placed in the navigator's room convenient to the officer of the watch, who may likewise use its indications at will to assure himself that the engine is turning at the prescribed speed.

As regards accuracy, a large number of trials made with this log have shown an approximation within one per cent., a value quite sufficiently accurate for all requirements of navigation.

The same trials have shown that the arrangements for handling the cord are entirely satisfactory and adequate for the purposes required. The register first employed, however, gave some trouble and occasionally allowed a signal to escape. A new apparatus is soon to be given extended trials on two high-speed cruisers, and it is expected that full satisfaction on the latter point will be given.

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* Translated for MARINE ENGINEERING from *Comptes Rendus*, May, 1903.

METHODS OF SECURING WATER-TIGHTNESS OF PLATES AT CONDUIT AND TUBES.

BY GEORGE MCQUILKIN, JR.

When a plate is pierced by conduit or tubing it is generally required that the conduit or tubing shall be water-tight at the plate, and especially is this true in the case of a deck or a water-tight bulkhead. This requirement has developed a number of devices, an inspection of which will reveal the same principle, that of compressing packing externally on the conduit or plate. Each shipyard has its favorite type, and these, in addition to the shipowners' standards, make an attempt at standardization of this important fitting fruitless, and a composite fitting taken from those at the command of the writer would not appear to secure the most desirable fitting. No attempt has been made to secure all the types in use, but to illustrate a sufficient number in order to point out the variety, with the hope that some attention and thought will be brought to bear on this important but oft-neglected fitting.

To preserve the water-tightness of the compartments of a ship when the plates are pierced for the installation of conduit or tubing, the most simple and effective means would appear to be that of tapping the plate and threading the conduit into the plate. This would necessitate the use of unions, flanges, or right- and left-hand couplings when desired to make the conduit continuous, and in the use of such fittings precaution need be taken to make the joint water-tight externally. The additional expenditure of labor and fitting would appear to be unnecessary when the result can be secured by other means. This method would not be practical in a thin plate, for the plate would not have sufficient thickness to tap the number of threads necessary to secure the water-tightness of the conduit.

For pipes under internal pressure the method of flanging the pipe at the bulkhead or deck is in general use, but this method would not appear to be adaptable to conduit or tubes in which the protection desired is from external pressure. The stresses in a pipe under internal pressure are different from the case under consideration, where we may consider the only stresses that have any effect are those of the vibration or differences in position of the bulkheads or decks when the vessel is loaded and when the vessel is empty. Generally speaking, this stress is unimportant in the installation of conduit because of the latter's relatively small size and its installation near the fixed points of a plate.

The accompanying figures illustrate a number of appliances that are in use. Fig. 1 illustrates a plate into which the conduit is threaded. It will be seen that to continue the conduit, a coupling will be necessary, and that if the conduit has a standard taper thread the coupling must be threaded so as to fit that taper before it comes into contact with the plate, otherwise the threads will not fit and this will be likely to leak. This can be prevented by threading the conduit for a sufficient length to project through the plate, and then "cupping" the end of the coupling and filling the cupped portion with packing which is compressed by a half coupling for this purpose. This method can be installed in a space equal to the outside diameter of the coupling, and the hole in the plate will not equal the outside diameter of the conduit. It will be seen that if the conduit were to lead down the plate on the opposite side, this method would make necessary the offsetting of the conduit to bring it nearer the plate after it had pierced the plate, and that in the use of the larger sizes of conduit no little space would be required to make a bend to accomplish this.

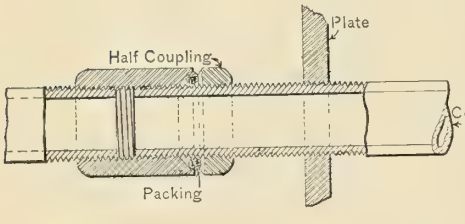


FIG. 1

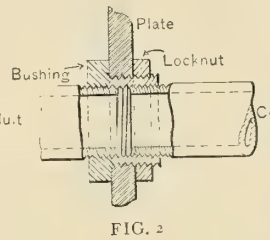


FIG. 2

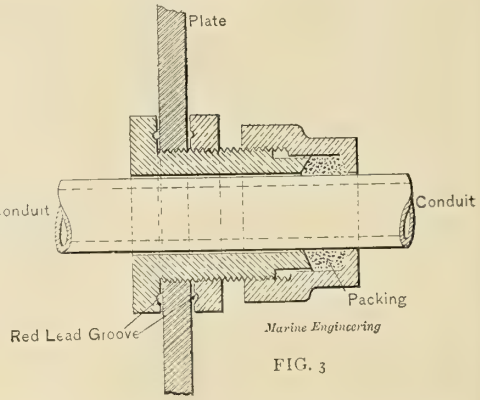


FIG. 3

Fig. 2 illustrates a method used for thin plates, the bushing being screwed into the plate and then clamped to the plate by a lock nut on one side, the grooves of the nut and the head of the bushing next to the plate being liberally treated with red lead. In this case the only precautions necessary are that the threads on the conduit are not too full and the threads on the bushing are tapped from both sides so as to have the proper taper. The greater surface of the bushing gives a bearing on the plate sufficient to make a water-tight joint, and the threading of the bushing into the plate serves to make a rigid connection to the plate. This method requires a space on the plate equal to 2 1-4 times the diameter of the conduit, and a hole in the plate equal to 1 3-4 times the diameter of the conduit.

Fig. 3 illustrates the principle of many devices used for this class of work, and consists of two lock nuts for compressing the packing against the plate on one or both sides, and a stuffing box to contain the packing which is compressed by a gland. This requires twice the diameter of the conduit for the hole in the plate, and a space 2.7 times the diameter of the conduit. A slight modification is made in this device by screwing one end of the conduit into the end of the box, the end in the packing end being cut off square. This admits of having a fixed point in the line and yet allows of the

longitudinal movement of the conduit. Its length is greater than either of the above methods, and this is objectionable when it is desired to pierce the plate and turn at a right angle and run the conduit parallel to the plate.

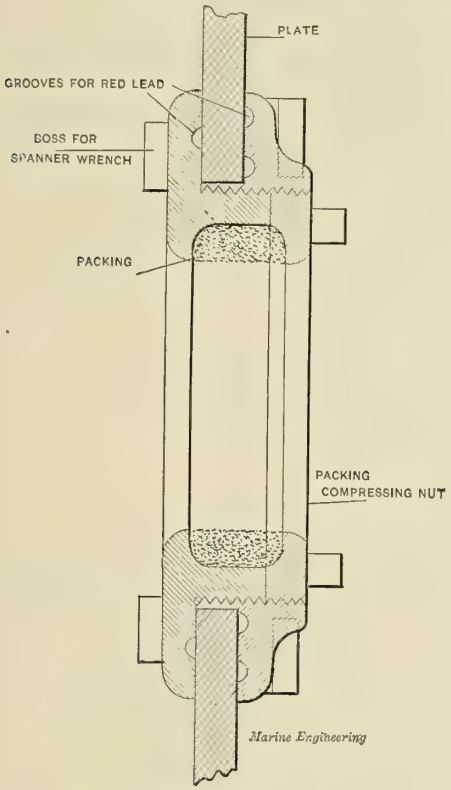


FIG. 4

Fig. 4 illustrates a device of size to admit of the packing occupying a space equal to the thickness of the plate plus the thickness of the two nuts on either side of the plate. This method also has the same objection as the two types previously described, in that there are two points of leakage exposed on each side of the plate, namely, at the plate and the nuts, and at the packing. Its size is out of proportion to the results gained, as the hole in the plate is about twice the diameter of the conduit, and the space required about three times the diameter of the conduit.

Fig. 5 is practically the same as Fig. 4, with the exception of the manner of forcing the gland down on the packing. It has the same objections as Fig. 4, and it also requires more longitudinal space for the studs for the packing-box nuts. It requires a space on the plate equal to about 3 1-4 times the diameter of the conduit, and a hole in the plate equal to about twice the diameter of the conduit.

Fig. 6 illustrates a device now used for the naval vessels, superseding an old method that has three exposed points of leakage and requires 2 1-2 feet of piston packing to fill the box. It requires a space on the plate equal to nearly twice the diameter of the conduit, and a hole in the plate equal to 1 1-2 times the diameter of the conduit. Its longitudinal length is greater in compari-

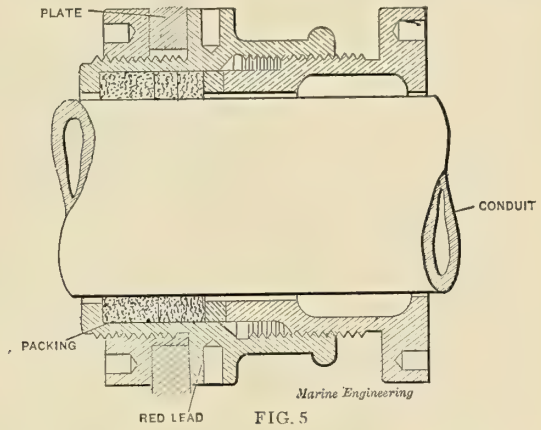


FIG. 5

son with the similar types. Fig. 6, the naval type in use at present, has all the objections stated above. The packing in this type is of soft rubber, which rapidly deteriorates, especially when installed on plates exposed to temperatures above the normal. This feature requires attention and tends to making the device untrustworthy. The rubber gasket is usually fitted after the installing of the conduit, the gasket being split in the direction of its axis and slipped into place around the conduit. The compression of the gasket by the gland is not always sufficient to close the split in the gasket, the conduit is not exactly concentric with the stuffing box, and the removal of the gland for examination does not always reveal the true state of the gasket when under compression. This method requires a hole in the plate equal to nearly 1 1-2 times the diameter of the conduit, and a space nearly equal to 2 1-4 times the diameter of the conduit.

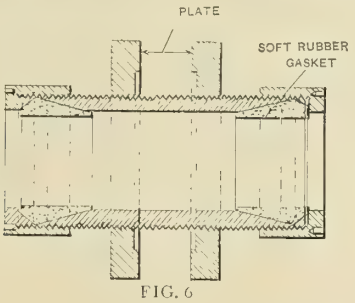


FIG. 6

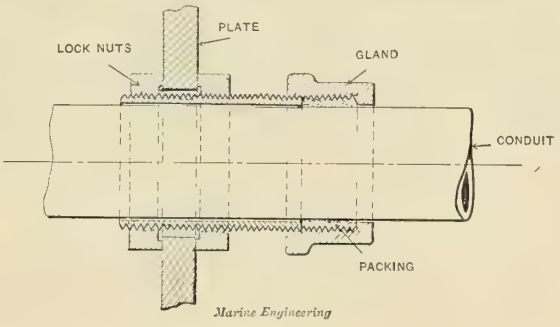


FIG. 7

Fig. 7 shows a device that has also been used to some extent on naval vessels. It has the same number of points exposed to leakage as the device above. A

peculiar feature of this is that in order to use standard lock nuts and pipe caps (for the gland), the next largest size of these fittings for the alternate sizes of conduit requires two kinds of packing, 1-4-inch flax and corset-lace packing. That is, the 1-2-inch conduit would have 1-inch nuts and cap (gland) and use corset-lace packing; the 3-4-inch conduit would have 1 1-4 nuts and cap and use 1-4-inch flax packing; 1-inch conduit, 1 1-4-inch fittings and corset-lace packing, and so on. This device requires a hole in the plate equal to 1.3 diameters of the conduit, and a space equal to 1.6 diameters.

Fig. 8 shows a device that was designed to be fitted after the conduit was in place. It requires two bolt holes in the plate to clamp it to the plate and compress the packing. This type admits of a turn being made and the conduit being run parallel to the plate, but the objection to it is that the bolt holes are likely to leak, due to the working of the conduit or the plate, even though water-tight when first installed. This device requires a hole in the plate equal to the diameter of the conduit, and a space on the plate across the major axis and minor axis, respectively, equal to nearly 3.7 and 1.5.

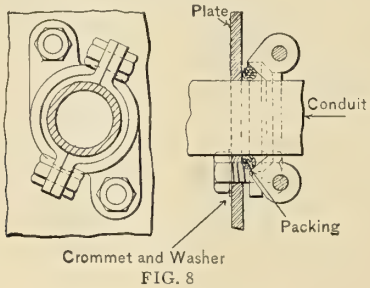


FIG. 8

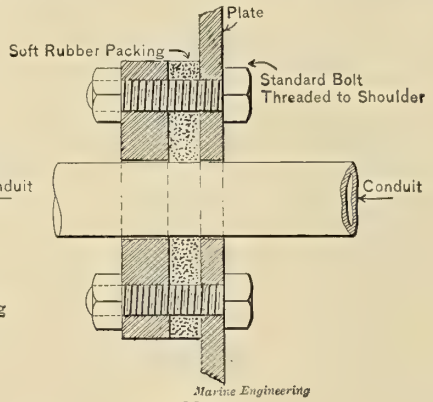


FIG. 9

Fig. 9 shows a device that is used when it is necessary to install a number of lines through a plate in a limited space—a condition that frequently occurs. This type necessitates the packing of the bolts in the plate, and care used when making the rubber packing for the conduits so that it fits very closely. The holes in the plate must have very little clearance or the rubber will be forced into a hole and will not make a satisfactory job. Numerous variations of this method are in use, the principal one being a plate of sufficient size to contain the necessary boxes with packing glands, fastened to the bulkhead by bolts or studs, the joint between the two being treated liberally with lead or packed with sheet rubber.

Fig. 10 shows a simple method that has a wider use than any of the devices described above. The simplicity of the parts and the ease of installing recommend it. It consists of threading the conduit for a few inches, or, as it is known, a "long screw," and with the liberal application of lead or the use of a grommet to make the joint between the plate and the nuts water-tight. In some cases a washer is used to secure more surface at the joint. A washer is always used when the joint has to be made on a wood deck, in order to prevent injury to the deck. In the latter case the best method would be to install the conduit before the deck is laid, making the joint at the plate, and when the deck is laid to calk the space between the deck and the conduit. In naval installations the nuts are made of composition or other soft metal, and a groove turned in the nut to form a recess for the lead or packing. The nut, being softer than the plate or the conduit, will, in every case where ordinary pressure is applied to tighten the nut, conform to slight inequalities of alignment. This method requires a hole in the plate equal to the diameter of the conduit, and a space on the plate equal to 1 1-2 times the diameter of the conduit. For continuous lines a half coupling, as described above, abuts the ordinary coupling to make that connection water-tight. The conduit may make a short turn on the plate after passing through, if the threads are cut full and the face of the elbow machined square so as to abut the nut, the whole being treated with lead.

The important features of the above devices are their weight and the ease of installing with respect to the degree of durable water-tightness secured. At a first glance the size and use of the fitting would not probably appear to justify any thought on their improvement,

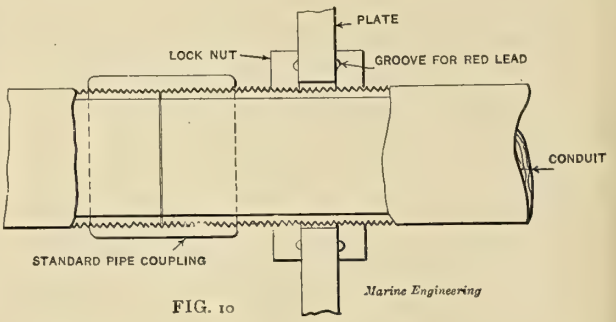
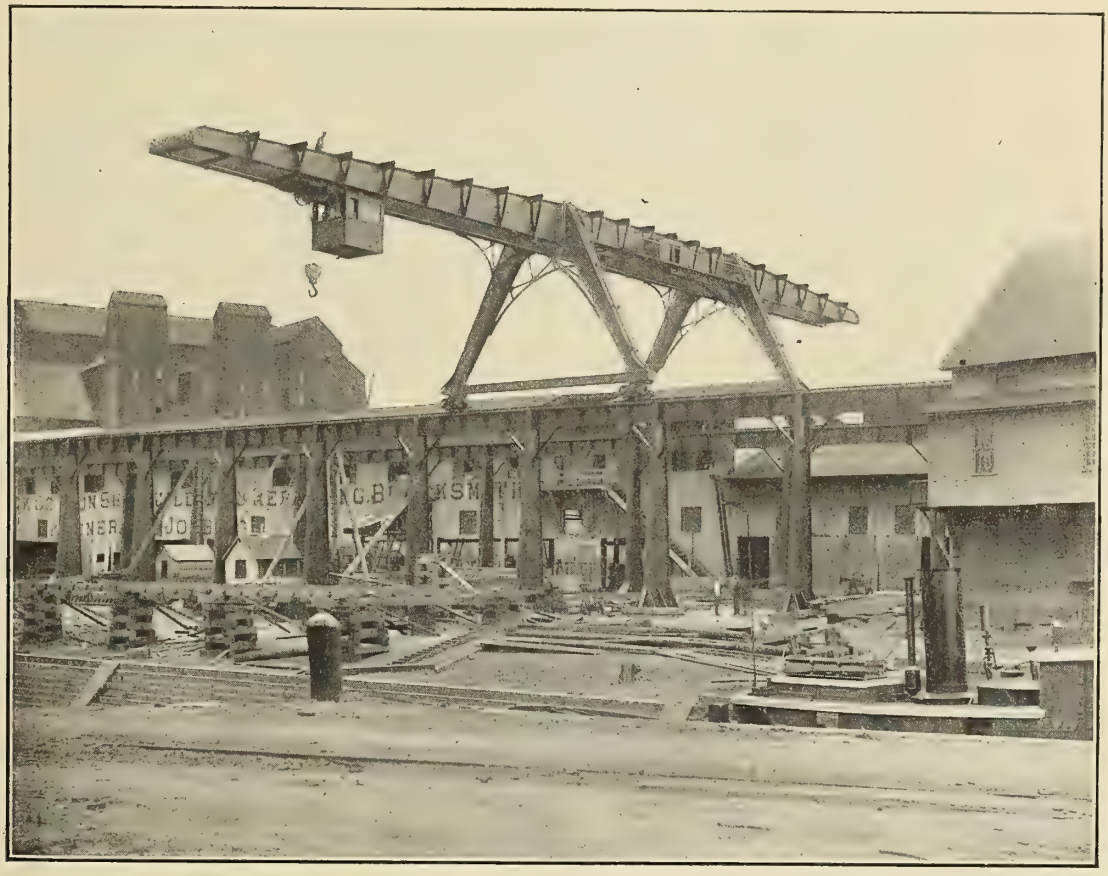


FIG. 10

but if one considers the total number of fittings used on a single ship, as well as the numerous instances of piercing a plate with conduit or tubes, the fittings should not be ignored. The rapidly increasing number of conduit pipes and voice tubes necessary in the equipment of a modern vessel would seem to demand the standardization of these fittings for merchant vessels as well as for naval vessels, there being no difference in the results desired by their installations.

GANTRY CRANE OF THE BUFFALO DRY-DOCK COMPANY.

For the purpose of handling material at the Buffalo works of the American Shipbuilding Company, there has been built a large cantilever crane, as shown in the engravings. This crane travels on a steel runway made up of 17 bays, 24 feet centers each; thus the total length of the runway is 408 feet. The crane has a central span of 45 feet and a cantilever 73 feet long hanging over the building berth and extending out to the dry-dock. At the opposite end there is a 48-foot cantilever hanging over the ship shed.

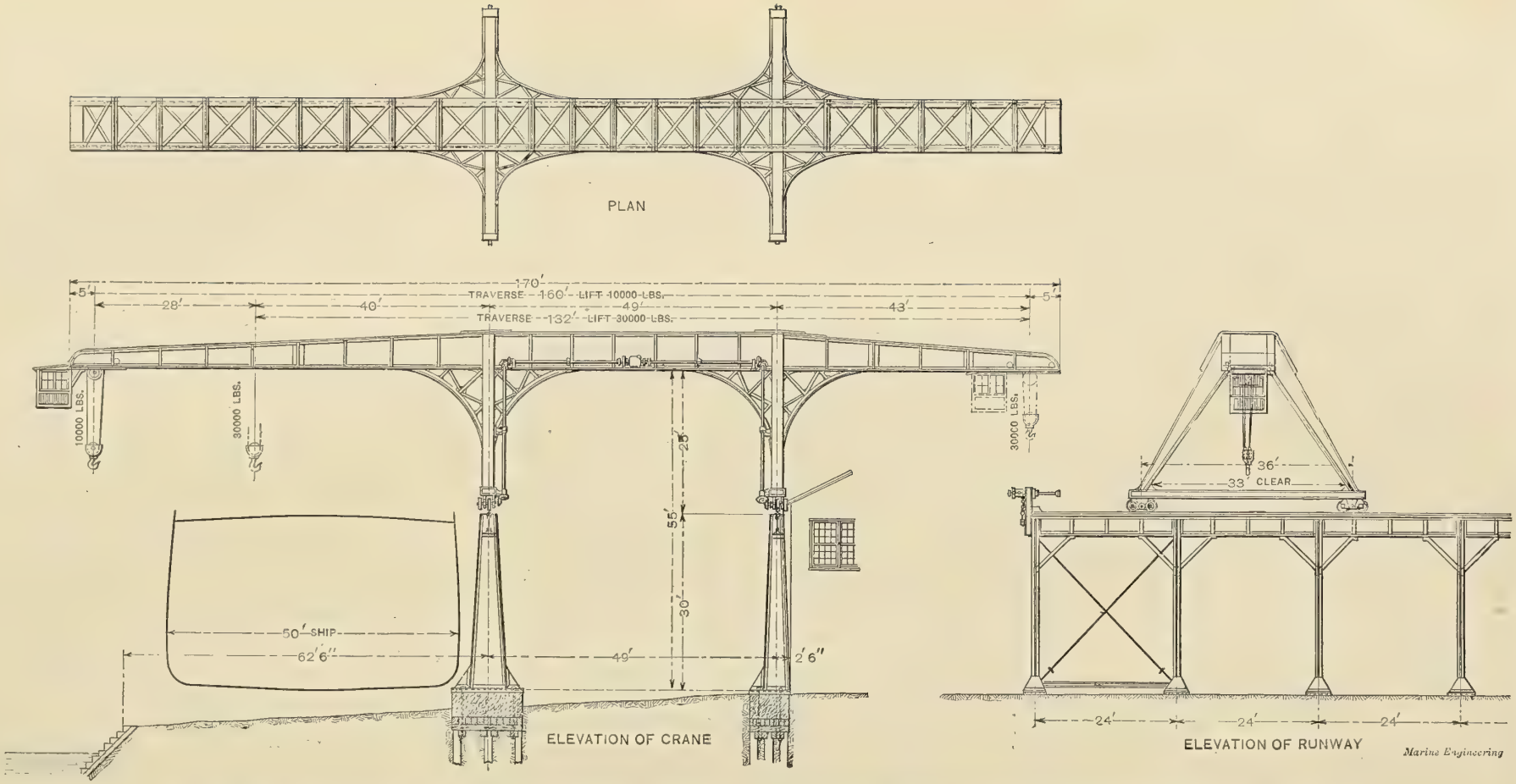


THE 15-TON GANTRY CRANE OF THE BUFFALO DRY-DOCK COMPANY.

The crane consists of two girders thoroughly braced and tied together at their top flanges, and having rails rigidly connected to the inner bottom flange, upon which the trolley travels. These inner flanges are stiffly braced from springing outward. These girders, which are of single-web type, are supported on and rigidly connected to A-frames, the legs of which are built up of plates and angles to form a box section, and have their lower extremities rigidly connected together by heavy lattice channel I-beams. The girders are stiffly braced to the A-frames by neat circular knees, the knees being thoroughly braced and stiffened.

Under each of the legs of the A-frames are two wheel trucks, which consist of a heavy casting arranged in an equalizing joint so that the load is equally distributed on both the wheels. The wheels are of double-flange type, keyed to heavy steel axles and carried in bronze bearings provided with oil boxes, the arrangement being so that by the removal of two bolts the wheels, together with their bearings, may be taken out. The wheels on two of these trucks, one under each A-frame, are geared to a motor, carried on the side of the girders, by spur and bevel gearing and shafting. The bevel gearing is provided with thrust bearings and covered with sheet-iron casings. The trolley consists of a heavy steel framework, supporting the hoisting drum. The lifting tackle is made of extra pliable plough steel wire rope.

The lifting capacity of the crane is 15 tons throughout the length of the central span and the 48-foot cantilever, and to a position of 40 feet from the A-frame on the 73-foot cantilever, and a lifting capacity of 5 tons at the extremity of the 73-foot cantilever. With loads as noted above in their extreme position there is no tendency for the crane to overturn, but in case the 15-ton load were run to the extreme of the 73-foot cantilever, there are safety hooks arranged on the trucks engaging in the runway girder flange, so that there is no possibility of the crane being overturned. These safety hooks are placed only at the flange at the 48-foot cantilever end, as the crane would lift a 50 per cent. overload at the extreme end of this span without overturning the crane or lifting the trucks under the A-frame at the 73-foot cantilever end.



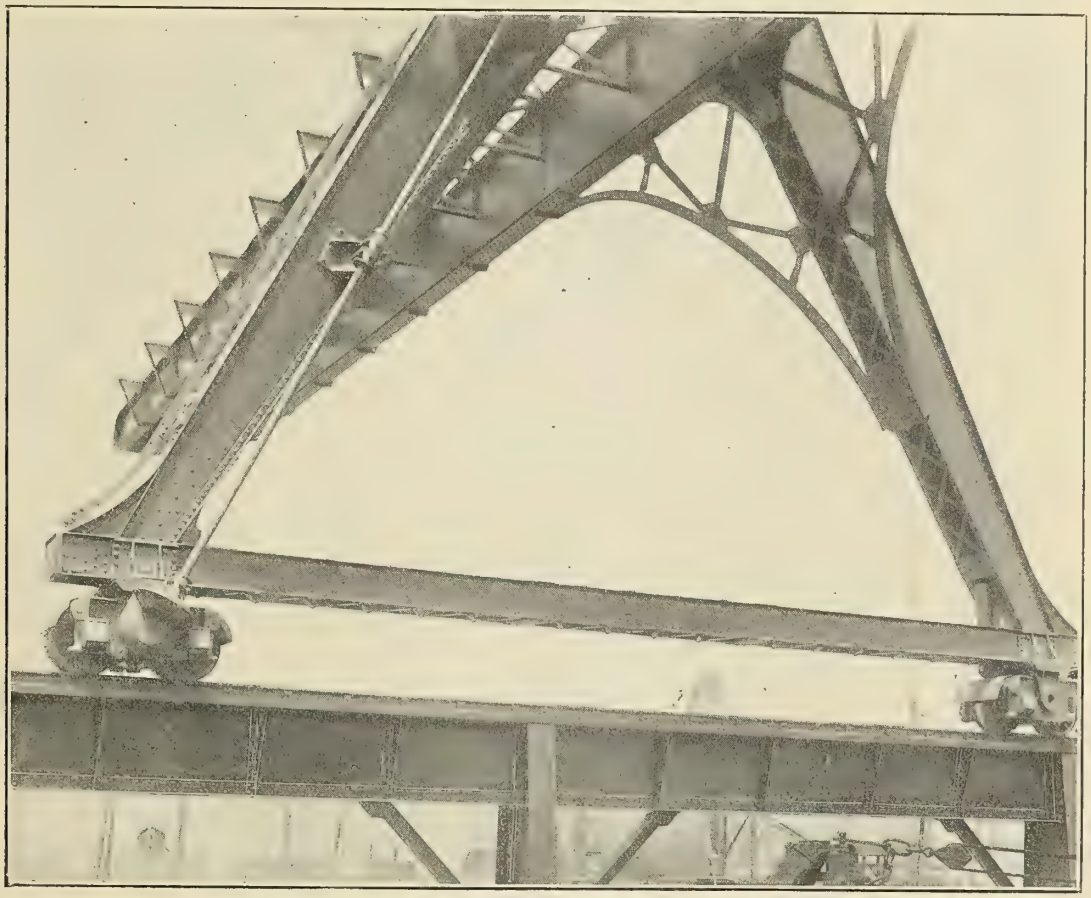
PLAN, ELEVATION, AND SECTION OF GANTRY CRANE AND RUNWAY BUILT BY THE WELLER-SEAVER ENGINEERING COMPANY FOR THE BUFFALO DRY-DOCK COMPANY.

The runways consist of single web girders having their top flanges thoroughly stiffened laterally by horizontal plate girders. These girders are supported on heavy columns spaced to suit the requirements of the yard. They consist of plate webs with heavy angle flanges, having very wide bases, which are thoroughly anchored to substantial concrete foundation piers carried on piles. At either end of the runway are placed buffers, consisting of heavy cylinders, having plungers with pistons working in oil, with conical rods working in openings in the piston, thereby producing the necessary retarding effect when struck by the crane, due to the carelessness of the operator or other accidents. The arrangement of the crane is such that the material may be taken from the ship and deposited in the yard under the central span for future use, or directly to the building berth, where it can be handled to its exact position on the ship. The long cantilever is of such a length that the material may be lifted direct from the scows in the dry-dock and carried to any point required.

All the operations of the crane are controlled from the operator's cab, which is hung from and carried with the trolley, so that the operator always commands a full view of his work. The electric motors and other equipments are actuated by an alternating current and were installed by the Westinghouse Electric and Manufacturing Company.

The crane with its runways was built in the spring of 1898 and has been in constant use from that date. During this period of time it has received some very severe tests by lifting loads much in excess of its rated capacity.

The engineers and contractors for this crane service were the Wellman-Seaver Engineering Company, who designed and installed the service complete.



VIEW OF AN A-FRAME LEG, WHEELS, AND DETAIL OF GANTRY CRANE.

Fast Yacht.—On September 19 the Indian Harbor Yacht Club held a race for steam yachts. The race was for vessels of over 100 tons gross and between 100 and 150 feet on the water line. The race was won by Commodore Frank Tilford's *Norman.* According to reports she steamed over the 50 nautical mile course in 3 hours 1 minute and 29 seconds. The *Norman,* which was formerly the *Uneonta,* was designed by Gardner and Cox and built at the Delaware River Iron Shipbuilding and Engine Works. In 1901 she was rebuilt by the W. and A. Fletcher Company.

Modern German, English, and American Electric Launches.—III.

BY FRANK C. PERKINS.

Having already described briefly and illustrated some of the electric launches as built and used in Germany and England, we will now consider some of the latest designs of electric boats as constructed in America. One of the principal charging stations near New York, as well as the most noted electric boat-building plant in the United States, is that of The Electric Launch Company at Bayonne City, New Jersey.

It is acknowledged that the electric launch is the most desirable boat for pleasure, providing there are suitable charging stations available. It is claimed to be the safest of all forms of pleasure boats, as it cannot explode, carrying no inflammable fluid of any kind. When metallic air tanks are provided underneath the decks of sufficient size, the boat cannot sink, and the operation is most simple and can be controlled by any person who can steer a boat.

The motor is simple and noiseless, and is located under the flooring and direct-connected to the propeller shaft, while the batteries are grouped either beneath the flooring or under the seats. There is no odor, heat, noise, or smoke from these pleasure boats, and when the motor stops there is no expense of consuming fuel without doing any work.

The electric fishing boat is very desirable, as its noise-

less electric power and ease of control are decidedly in its favor for this sport as well as hunting. In America the commercial building of electric launches was started about ten years ago, and at the World's Fair in Chicago 55 electric boats were in operation, each 36 feet in length and capable of seating 35 persons. These boats were given the most severe service, and an excellent opportunity was thus at hand for testing as to speed, strength, reliability, and satisfactory working of every electrical feature.

A popular type of electric launch is the 30-foot boat built for Robert P. Linderman, of South Bethlehem, Pa. This pleasure craft is fitted with long fly awning, cane chairs and other finely upholstered seats, and is operated on Long Island sound at Fisher's island. The boats may be charged from any direct-current plant of either 110, 220, or 500 volts, and the usual cost is 10 cents per Kw., or, for this size of craft, 20 to 40 cents per hour of charging. The time of charging is from three to five hours, according to the state of the batteries. These electric launches are provided with a switch which is fitted with spring contacts to hold a charging plug to which the service wires have been attached. By inserting this plug and closing the lever arm upward the circuit for charging is established. This switch has also a small key, or running plug, which closes the main circuit to the batteries, and when removed and carried by the owner the operation of the boat is absolutely prevented.

There are two neat electric launches on the Upper Saranac lake and Lake George, N. Y., one of which is 30 feet long and the other 36 feet long, the freeboards being 24 and 26 inches and the breadths 6 feet 4 inches and 6 feet 10 inches, respectively. These launches have a draft of 24 and 26 inches, and carry from 12 to 30 passengers at a speed of from 6 1-2 to 8 miles per hour. The radius of action is from 40 miles at a medium speed of 6 1-2 miles with a light battery, to 65 miles with larger, heavier cells.

On Schroon lake, N. Y., is an 18-foot electric boat specially built for hunting and fishing. It is noiseless at all speeds, and the motor is located under the rear seat and the batteries under the center seat. This boat has a beam of 4 feet 4 inches and a freeboard of 16 inches, with a draft of 16 inches. The motor is of the 1 1-2 horse-power enclosed type, water-tight, and propels the boat at about 5 1-2 miles per hour. It will carry from 4 to 6 persons comfortably, and has a radius of action of 25 miles at 4 1-2 mile rate with light cells of battery and 45 miles with the larger battery.

On Orchard lake, Mich., there has been in operation a 36-foot electric launch, of the low freeboard type and fast speed for lake and river service, known as the *Karuna.*

One of the most luxurious electric launches in use in the United States is the *Sovereign,* built by The Electric Launch Company of Bayonne City, N. J., for Mr. C. D. Borden, of New York. This electric boat has made a speed of 10 1-2 miles per hour over a measured course on the Shrewsbury river.

The electric cabin cruising yachts of 42, 54, and 63 feet lengths are equipped with batteries and motors capable of propelling the boats from 120 to 145 miles at medium-rate speeds of 8 1-2 to 9 1-2 miles per hour. These boats are very finely equipped with searchlight, and upholstered seats for from 30 to 70 passengers. The larger electric cabin cruising yacht has sleeping accommodations for four and a crew of two.

AMERICAN-BUILT ELECTRIC LAUNCH.

The 36-foot electric passenger boat in service on Central Park lakes in New York city has stored energy for intermittent or ferry service of 12 to 14 hours. The average speed of this boat is 6 to 8 miles per hour and it has a seating capacity of 40 passengers.

During the Pan-American Exposition the electric launches were a well-patronized feature of the exhibition and consisted of 11 30-foot boats. They were in service from May 15 to October 31 and carried 85,700 passengers, and it is remarkable to note that there was not one accident throughout the entire time, which is a good record for electric service of this character.

A still larger passenger boat propelled by electricity is the 42-foot launch operated by the Omaha and Council Bluffs Railway and Bridge Company, Iowa. This large electric boat will carry nearly 100 persons and has a seat-

ing capacity for 70 adults. It is equipped with 44 storage cells of a special marine type, and has a radius of action of 75 miles at the medium rate of speed of 6 1-2 miles per hour with the heaviest set of batteries. It is 8 feet broad, draws 26 inches, and has a freeboard of 22 inches. It is operated by a 6 horse-power electric motor of the enclosed water-proof type, and is built with a standing roof with storm curtains.

A 30-foot electric gig or yacht tender was constructed several years ago in this country for the U. S. S. *New York,* but on completion was transferred to Grand Duke Alexander of Russia. Another, larger boat was built later for the *New York,* 31 feet long. These electric

36-FOOT ELECTRIC LAUNCH USED ON CENTRAL PARK LAKES, NEW YORK, N. Y.

gigs are no heavier than those having steam or naphtha engines with their coal bins or their tanks filled. Each boat's equipment has a battery capacity for a continuous run of about 3 hours at full speed, or 5 to 6 hours at a little less speed, and it is capable of very high speed for short spurts. There is no loss of electricity when the motor is not running, and the gig will give intermittent service during several days before recharging is necessary. A full recharge requires from three to four hours. Each electric gig is supplied with voltmeter, which shows approaching exhaustion of the stored energy. The electric gig is instantly available after being lowered, and is a model of cleanliness and simplicity, with entire seating space free for passengers.

EVAPORATORS AND DISTILLERS.

BY W. W. EDWARDS.

The problem of securing fresh water at sea has been solved in various ways during the time that men have gone down to the sea in ships. In the earlier days of navigation, when wind was the only motive power, water was taken aboard in casks in sufficient quantities to last until land was again sighted, where the supply could be replenished. This somewhat precarious method fulfilled the requirements until the introduction of steam increased the demand for fresh water far beyond the available carrying capacity of the ship to supply. Engineers were therefore forced to turn their attention to the production of fresh water from the sea, and the result has been a class of apparatus known as evaporators, whose development makes an interesting study for the engineer.

It is known that when water boils, all impurities, except those that are easily volatilized, remain in the vessel, while the water in the form of vapor passes off into the atmosphere. In the case of an evaporator, if this vapor is collected and condensed, it is found that the resulting water is almost absolutely pure and in this state is much superior for boiler feed to any water obtainable ashore. The term "almost absolutely pure" is here used advisedly in view of the fact that chemically-pure water is a laboratory curiosity and is not the product of any evaporating plant aboard a ship, regard-

less of any claims of interested parties to the contrary. As evaporation continues, more sea water is admitted to the evaporator to maintain the water level, and, as it brings its impurities with it, salt and other foreign matter continue to collect until this water holds five to eight times as much salt as does an equal volume of sea water. When this point is reached, the entire charge of highly concentrated brine is forced back into the sea and the vessel refilled.

The similarity of these operations, such as boiling the water to produce steam and blowing out the concentrated brine, to those that are practiced around the boilers of a ship, at once suggested the use of one of the main boilers as a producer of fresh water. Accordingly we find that, before evaporators were regularly manufactured and installed as part of a ship's equipment, either one of the main boilers or the donkey boiler was actually used for this purpose. The only attachment required, in addition to those fitted to the boiler for the generation of steam for power purposes, was that a separate line of piping should connect the boiler with the condenser. This method was followed for a time, and in some ships the donkey boiler is still used in this manner.

The disadvantages of the use of a boiler for distilling purposes are so great and so evident that it is only necessary to mention them. They are the loss of the boiler for power purposes, the great weight and space for the purpose that is served, the difficulty of close regulation, the care that must at all times be exercised, and the loss in fuel. To meet these objections the modern evaporator has been designed; and when it is considered that only about one-tenth of the space is occupied that the boiler requires, that the weight of the evaporator is a very small fraction of the weight of the boiler, that heating the water by means of steam coils is capable of the closest regulation by valves, and that the expense for fuel is greatly reduced, it is seen how completely the evaporator fulfills the purpose for which it is intended.

MODERN PLANTS.

A modern distilling plant is shown in Fig. 1. The evaporator, *A*, is seen to be cylindrical in form and is usually placed on the engine-room floor plates. Alongside the evaporator is placed the distiller, *B*, for the purpose of condensing the vapor from the evaporator. A word concerning the propriety of applying the term "distiller" to an apparatus whose sole purpose is the condensation of vapor, may not be out of place here. It is a term that has come into use by seagoing engineers in order to distinguish this apparatus from the main condenser. Properly speaking, however, distillation is the entire process of evaporating water and reconverting the resulting vapor into water again, and the term distiller should refer to the whole plant; but, for the reason mentioned above, it has only been applied to the condensing part of the plant.

It will be noticed that the vapor pipe, *P*, is first carried vertically upward and then over to the distiller. The reason for running the vapor pipe in this manner is to prevent any entrained water that may be present in the form of drops from being carried over into the distiller. The vertical direction of the vapor pipe tends to assist the return to the evaporator of all entrained water by the action of gravity. This is an important point to be observed in the installation of a distilling plant, as the entrained water is unevaporated and consequently contains all the impurities that are to be found in sea water. Any evaporator that primes will not make fresh water, and the successful operation of a distilling plant requires that the vapor from the evaporator shall be 100 per cent. dry steam. This is of so much importance that unusual designs are sometimes resorted to in order to obtain the vertical length of piping. On the United States cruiser *Chicago* the vapor pipe is carried about 25 feet from the evaporator platform up the engine-room hatchway and then back again to the former level to the distillers, in order to obtain the vertical length of piping. There are a great many installations of evaporators where no unusual efforts are made to run the vapor pipe vertically, but it is better to have the distiller on a higher level than the evaporator, and if the pipe has a vertical section the chance of making salt water is minimized.

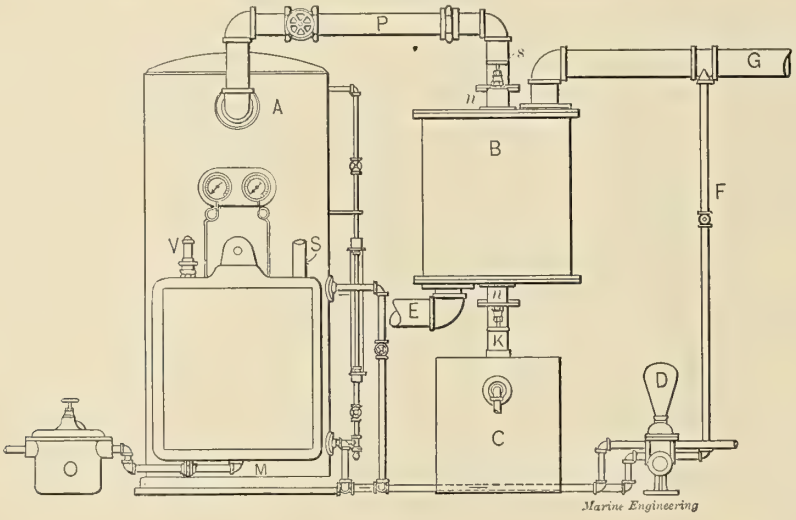


FIG. 1.

The vapor pipe is connected to a small fresh-water manifold, *n*, on the top of the distiller, *B*. This mani-

fold is secured to the top head by means of tap bolts, and its purpose is to distribute the vapor from the pipe *P* to the ends of three condensing coils that are within the distiller shell. There are valves that fit over the ends of the condensing coils, whose valve stems, shown at *s*, extend through the top of the manifold. The purpose of these valves is to enable the engineer to cut out any one of the coils that may be leaking. A similar manifold with similar valves is fitted on the bottom head of the distiller, in order to collect the fresh water from the coils and discharge it through the pipe *K* into the receptacle below. The valves in the lower manifold are for the purpose of sealing the lower end of any coil that may be leaking salt water.

Connected to the upper part of the upper fresh-water manifold is a valve known as the aërator, the purpose of which is to admit air to the vapor before it is condensed. This valve is not shown in the figure. It operates as a check valve, opening inward, so as to prevent the escape of vapor should the pressure within the vapor pipe exceed that of the atmosphere. Owing to the condensation within the distiller coils, there is usually a partial vacuum in the vapor pipe near the distiller, and consequently air is taken in through the aërator. It is known, by those familiar with distilled water, that when water is perfectly pure it is most unpalatable and has a very bitter taste, and the reason that spring water is usually so sparkling and refreshing is

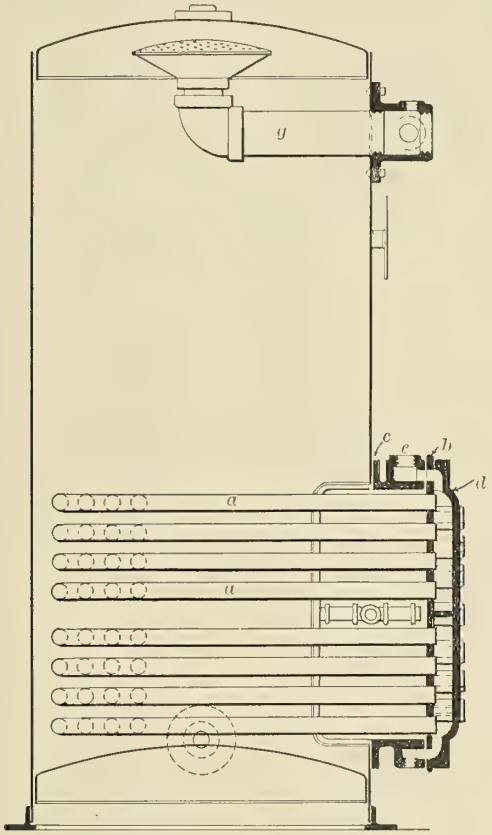


FIG. 2

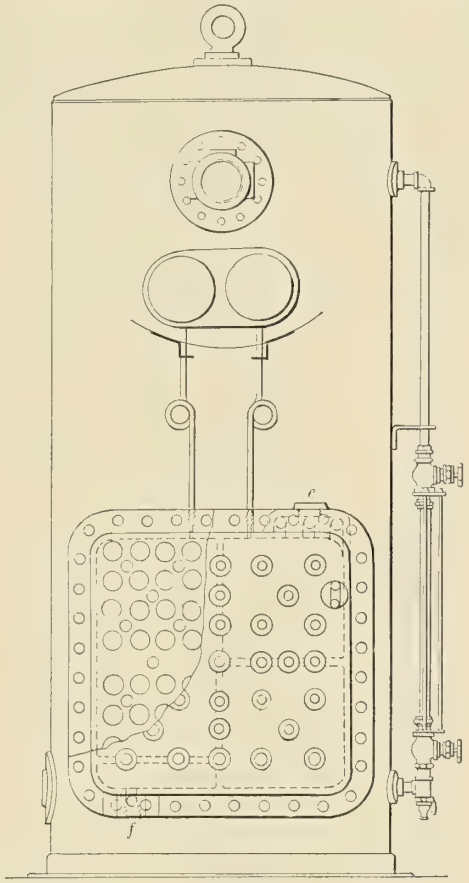


FIG. 4

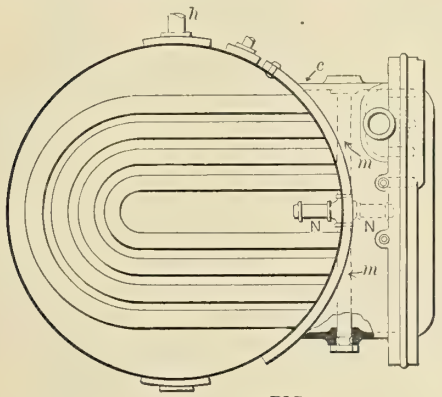


FIG. 3

FIG. 5

Marine Engineering

because of the air and other gases that have been absorbed by it during its passage through the earth. Some of the minerals contained in spring water are also well known to add to it refreshing qualities. Aërating the water tends to disguise the bitter taste and renders it much more agreeable when used.

The same purpose is served much more effectually by blowing air, by means of an air compressor, into the bottom of the fresh-water tanks when they are partially filled with distilled water. The bottoms of such tanks are made double, with the upper one perforated, and the air is blown in between the two bottoms and rises in small bubbles through the water.

Distilled water will absorb air by merely removing the manhole covers on the fresh-water tanks, and this will in time supply all the air that is needed to make the water agreeable to the taste. It is thus seen that the aërator is not an absolutely essential fitting to a distilling plant, as its function can be performed in other ways. The writer at one time had charge of the evaporators on the gunboat *Wilmington,* and cut out the aërator altogether for months at a time without injury to the water in any way. When the water first came from the distiller it was a trifle more bitter with the aërator closed than with it open, but by the time the water had been twenty-four hours in the fresh-water tanks the difference was imperceptible to the taste. The writer's opinion that the aërator is of doubtful utility has frequently been corroborated by men who have been engaged in the manufacture of evaporators for years.

At *C* is shown a filter, through which all the fresh water from the distiller must pass. It is usually fitted up in the interior with perforated trays on which are placed quantities of charcoal. While this receptacle is called a filter because of its similarity to filters used ashore, its real purpose is not to filter or purify the water, as distilled water needs no filtration, but rather to assist in its reabsorption of oxygen. It is a well-known fact in chemistry that charcoal will give up its oxygen to the water. This necessitates the renewal of the charcoal at intervals of about two months. The filter also serves as a reservoir to hold the water during any temporary stoppage of the fresh-water pump, and it also regulates any unevenness in the supply of water to the pump due to the rolling of the ship. The pipes connecting the filter to the other parts should have unions in them, in order to facilitate the removal of the filter while making repairs or renewing the charcoal.

The pumps required for an evaporator installation consist of a brine and feed pump, shown at *D,* and a circulating pump for the distiller. The brine and feed pump is direct-acting, with one piston rod and three cylinders. One cylinder (usually the middle one) is a steam cylinder for operating the pump, and the other cylinders are for feeding the evaporator and for pumping the concentrated brine overboard. It is sometimes the practice to use one end of this pump for pumping the fresh water into the storage tanks and to use the other end for both feeding purposes and removing the brine; the arrangement of the piping being such that this change can readily be made. A pump for removing the brine is not always installed, as it is possible to empty the evaporator overboard by blowing down under pressure or by allowing the brine to run into the bilge. There are objections to this, however, which will be discussed later, and the best practice is to install the brine pump.

The circulating pump is for the purpose of supplying the condensing water to the distiller, and almost any style of duplex pump is well suited for this purpose. This pump is not shown in Fig. 1, but the water enters the distiller through the pipe *E* and is discharged overboard through the pipe *G*. As the circulating water in the pipe *G* has had its temperature raised by the condensation of the vapor in the distiller, it is more economical to use this water for feeding the evaporator than water directly from overboard. Accordingly the feed-pump suction pipe is connected directly to the pipe *G*. As it is always necessary aboard a ship to have a pump running for sanitary purposes, it is usual to use this sanitary pump for the circulating pump of the evaporator plant, and where this is done the discharge from the distiller is connected to the flushing system of the ship. As the sanitary or flushing pump must run all the time, it is necessary to arrange by-pass piping around the distiller, in order to be able to cut out the distiller for repairs or during any interval when the evaporator may not be in operation.

Boiler steam, for the purpose of heating the water to be distilled, is passed through a reducing valve, set usually at 20 pounds, and enters the evaporator through the steam pipe *S*. The steam passes into the square head shown at the front of the evaporator, and from this head it enters the heating coils within the water space. As the steam gives up its heat to the water, it condenses and the water of condensation passes out through the drain pipe *M* to the steam trap *O,* which empties the water into the hot well. Fig. 1 shows the position of a safety valve, *V,* used on the heating coils, a water column for indicating the height of water within the shell, and two steam gauges for indicating the pressure of the steam in the coils and the vapor within the shell, respectively. Throughout this article the term vapor will apply to the steam arising from the salt water, to distinguish it from the boiler steam used for operating the evaporator. The general arrangement of a distilling plant as installed aboard a ship will be made evident from the foregoing description. It now remains to show the internal fittings of evaporators and distillers of leading makes, such as an engineer is liable to meet with in going aboard a ship.

SPECAL TYPES OF EVAPORATORS.

In Fig. 2 is shown an interior view of an evaporator manufactured by M. T. Davidson, of Brooklyn, N. Y. This evaporator is of the vertical type and is rated at a capacity of 1,500 gallons per twenty-four hours. The shell is made of boiler plate of 60,000 pounds tensile strength, and has a convex and a concave head at the top and bottom, respectively. This style of head is used because it obviates the necessity of internal braces. The heating coils, *a, a,* consist of U-tubes arranged in 8 layers with 4 tubes in each layer. (A plan view is shown in Fig. 3.) These tubes are expanded into a tube sheet, *b,* that fits over studs that are tapped into a casting, *c,* riveted to the evaporator shell. Over the same studs that hold the tube sheet there is placed a bonnet, *d,* so flanged that when the nuts on the studs

are drawn up tightly there is a space of 3 or 4 inches between the tube sheet and bonnet at all points except around the outer edge and along ribs. These ribs, shown very plainly in the front view in Fig. 4, project from the outer bonnet against the tube sheet in such a manner as to divide the space between the tube sheet and bonnet into four unequal compartments. Gaskets are placed between the casting *c* and the tube sheet *b*, and between the tube sheet *b* and the bonnet *d*, in order to make steam-tight joints.

Steam from the boiler is admitted to the tubes through the opening *e* in the casting *c*. This leads the steam directly into the upper right-hand compartment framed by the ribs and the outside flange of the bonnet, as shown in Fig. 4. From this compartment the steam flows through the upper nest of the U-tubes into the large compartment on the left. From here the steam passes through the three upper layers of the lower nest of tubes into the compartment in the lower right-hand corner of Fig. 4. The steam and water of condensation

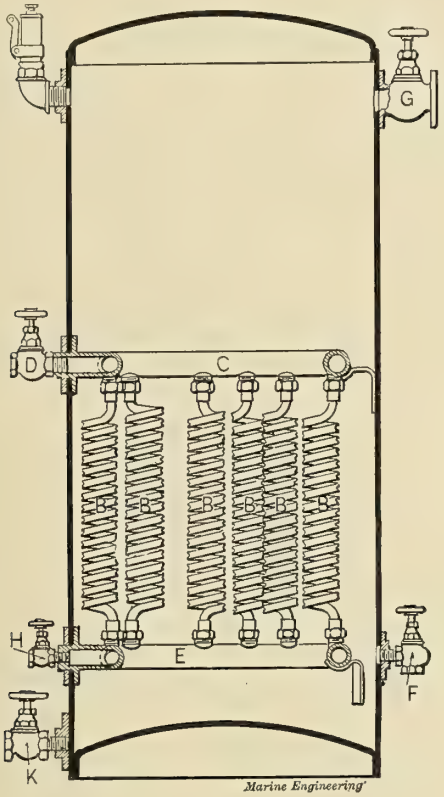


FIG. 6.

pass from this compartment through the lower right layer of tubes into the small compartment in the lower left-hand corner, and the water of condensation passes out of the evaporator at *f* into a steam trap. It will be noted that the entrance of steam at *e* and the drain *f* are both part of the casting *c*. This secures the very great advantage that it is not necessary to disturb any of the steam piping or drains when the heating coils are withdrawn for scaling.

The feed water is admitted to the evaporator through an internal feed pipe, shown at *m, m*, Fig. 3. This pipe extends across from side to side of the casting *c*, so that the external feed pipe can be connected to either side. The side that is not used can be easily closed with a pipe plug, as shown in Fig. 3. At the middle point of this cross pipe is placed a four-way fitting, so that two short pieces of pipe can be screwed in at right angles with the cross pipe. These short pieces are perforated with a large number of small holes, which tend to distribute the cold feed water instead of delivering it against the hot coils—an evidently important and desirable feature of feed-water distribution.

The two gauges are connected through casting *c*, the steam to the space between tube sheet and bonnet, and the vapor gauge to the space around the coils, as shown in Fig. 5. At *h*, Fig. 3, is shown the connection for the brine pump. This pipe should also have a connection directly to the sea, in order to blow down the evaporator under pressure whenever circumstances compel a resort to this method. The Davidson evaporators are also made with a horizontal shell to meet any requirements that restricted space may impose.

Another widely known evaporator is the Quiggins Patent Evaporator, manufactured by the James Reilly Repair and Supply Company, of New York. This evaporator is shown in cross section in Fig. 6. It is seen to consist of an upright cylindrical shell of boiler plate, with the upper head convex and the lower head concave in order to obviate the necessity of stays. There are two annular-shaped manifolds, *C* and *E*, in the interior, one about the middle of the shell and the other a few inches from the bottom. These manifolds are connected by a number of spirally-shaped coils, *B, B*. These coils are secured in place by means of unions, so that a defective coil can be removed and the openings capped or another coil put in place with only a few minutes' delay. This feature is a very valuable one, as a leaking coil can be repaired at the convenience of the engineer without causing a shut-down of the evaporator for a long period of time.

The evaporator coil is crescent-shaped. This shape has two advantages—viz., there is greater heating surface per unit volume of steam within the coils, and it is claimed that with this shape the coils are self-scaling because of the alternate expansion and contraction. Access to the interior of the shell is had by means of two manholes, one on a line with the lower manifold, *E*, and the other just above the manifold *C*.

The valve *F* is the feed-water valve through which the feed enters the evaporator; the valve *K* is the brine valve and is used for the removal of the concentrated brine. Boiler steam, usually reduced in pressure to 20 or 25 pounds, enters the heating coils through the valve *D* and manifold *C*, and when it has fulfilled its function and is condensed, it passes out of the evaporator through the drain valve *H* and a steam trap into the hot well.

When the vapor forms in the evaporator it passes out through the valve *G* to the distiller or main condenser, depending on whether the fresh water is to be used for drinking purposes or to make up losses in feed water. This evaporator is fitted with a safety valve, a steam gauge, a vapor gauge, water column, and other fittings necessary for its efficient operation.

DISTILLERS.

The apparatus for condensing the vapor from the evaporator depends upon the principle of all condensers —namely, the absorption of the latent heat of the vapor by cooling water from the sea. The form of the apparatus employed varies somewhat in different types of distilling plants and makes an interesting study for the engineer.

The commonest form used with the Davidson distiller is shown in Fig. 1 at *B*. In the interior of this distiller are arranged three concentric coils of copper piping having their ends opening into the space underneath the manifolds *n, n*. At each end of the coil is a shoulder, and then a thread on the ends of the coil. These ends pass through holes in the heads of the distiller under the fresh-water bonnets, and a nut is screwed over the end of the coil to keep it in place. A gasket of sheet lead is usually placed between the shoulders and the heads, and also between the heads and the nuts on the ends of the coil, in order to insure that there shall be no leakage of salt water into the fresh-water vapor as it is being condensed. Many times has an evaporator been unjustly blamed for making salt water when the fault was altogether in the distiller coils. The distiller coils are made of copper and are usually lined with tin in order to prevent poisoning the water with copper.

Distiller coils, being of peculiar shape, are not readily purchased in all parts of the world, and a distiller that uses commoner forms of cooling surface, such as ordinary condenser tubes, would be much more easily and cheaply repaired when away from home ports. With the purpose of obviating the necessity of using coils, this company has designed the distiller shown in Fig. 7. It is seen to consist of a long and comparatively narrow cylinder containing condenser tubes, *c c*. These tubes are expanded into the tube sheet *a* at one end, and at the other end they are expanded into a header, *b*, that fits inside the end of the outer shell. The outer shell forms a stuffing box around the header *b*, and is packed with any good hydraulic packing. The packing is held in place by means of a gland and studs, as shown in the figure. The purpose of having the header *b* free to move through a stuffing box is to allow for the expansion and contraction of the tubes *c, c*. The circulating water enters at *f*, passes through the tubes *c, c*, and leaves the distiller at *g*, thus keeping the tubes cool and condensing the vapor. The vapor enters at *d*, and the fresh water leaves the distiller at *e*. The coolest circulating water meets the coolest condensed water and vapor, and as the circulating water becomes hotter it passes to that part of the distiller where it meets the hottest vapor. This insures a much more gradual transfer of heat from the vapor to the cooling water, and also insures a much greater efficiency of cooling surface than would be the case if the coldest circulating water met the hottest vapor.

It is usual to have the cooling water pass inside the tubes and the vapor outside; but this arrangement is sometimes reversed and the vapor is passed through the interior of the tubes with the circulating water outside. Either arrangement works well. This distiller can be placed in either a horizontal or vertical position. The pipe connecting at *f* must be so arranged as to yield sufficiently to allow for motion of the header *b*, due to the expansion and contraction of the tubes. As has been before stated, the great advantage of this form of distiller is the substitution of ordinary condenser tubes that can be obtained anywhere, for the copper coils that must be especially manufactured for distiller purposes. There is not sufficient demand for these coils to warrant a merchant in a foreign port carrying them in stock. Usually they must be made to order, which means delay and considerable expense.

The distilling apparatus that is used with the Quiggins evaporator is shown in Fig. 8. It is seen to be very similar to the evaporator, in that it consists of a cylindrical shell containing two annular manifolds connected by spiral coils of copper piping. The vapor from the evaporator is led into the upper manifold at the point *A*, and, after passing through the spiral coils, is discharged at the point *B* as fresh water. The circulating water enters the distiller at *C*, and, passing upward around the coils, condenses the vapor within them. The hot circulating water leaves the distiller at *D* and

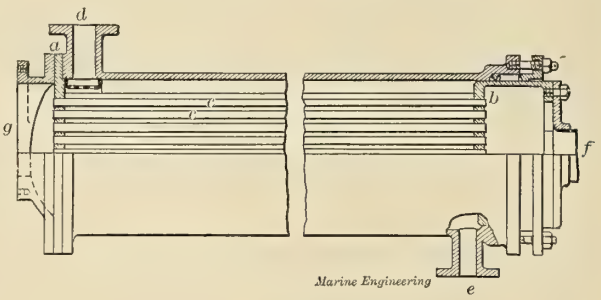


FIG. 7.

is discharged overboard. It will be noted that in this distiller also the hottest circulating water meets the hottest vapor. A great advantage of this type of distiller is that a defective coil can be readily removed by merely using a monkey wrench on the unions with which each coil is secured in place. The openings thus made into the manifolds can readily be capped and distillation proceeded with while the defective coil is being repaired.

EFFICIENCY OF PLANT.

The steam consumption of an evaporator is very nearly one pound of steam per pound of fresh water produced. This must be evident when it is considered that the total heat in a pound of steam is nearly constant, no matter what the pressure is, and consequently the heat in a pound of boiler steam would vaporize approximately one pound of the salt water. It is possible, however, to produce much more than one pound of fresh water per pound of boiler steam by having two or three evaporators connected in such a manner that the vapor from the first one is used within the heating coils of the second; the vapor from the second is used in the heating coils of a third evaporator. The drain from the heating coils of all the evaporators except the first should be discharged into the fresh-water tanks of the ship. This arrangement is called double or triple effect. It is necessary to use steam of comparatively high pressure

in the coils of No. 1, so that the pressure of the vapor from No. 1 will be sufficiently high to operate No. 2. It is better to have an air pump connected to No. 3, in order to reduce the pressure within the shell so that evaporation will take place at a comparatively low temperature. By using three evaporators the following evaporative results have been attained with 100 pounds weight of boiler steam:

Fresh water from the heating coils of No. 2, about 90 pounds weight.

Fresh water from the heating coils of No. 3, about 87 pounds weight.

Fresh water condensed from the vapor of No. 3, about 88 pounds weight.

Therefore, allowing 15 pounds for loss by blowing off, from the use of 100 pounds of steam we obtain 250 pounds of fresh water.

HOW TO RUN AN EVAPORATOR.

In the distillation of sea water in an evaporator there

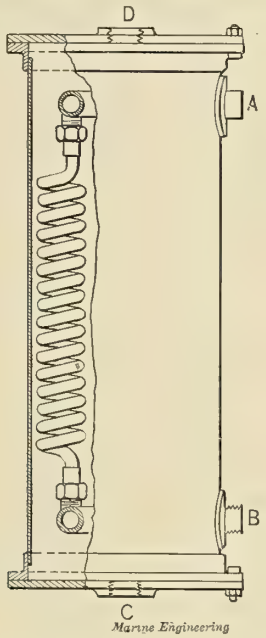


FIG. 8.

are certain rules and directions that should be followed in order to secure the best results. There is so little about an evaporator to get out of order that it will stand a great deal of abuse and still produce fresh water, but if the following directions are carefully observed the quantity of fresh water will be greatly increased and the work involved in keeping the evaporator free from scale, etc., will be greatly lessened.

The water level of the salt water in an evaporator should not be so high that all the coils are submerged. The reason for this is that the heating surface above the water level tends to dry the steam by vaporizing all the particles of water held in suspension, It is absolutely essential for the successful operation of a distilling plant that the vapor be dry before it leaves the evaporator, because the entrained water is as impure as the water around the coils. In the Quiggins evaporator nearly one-half of the heating surface is above the water level, and in the Davidson evaporator the top row of tubes is uncovered.

When the water level in the evaporator is at the right height, the circulating water should be started through the distiller, the valve on the steam pipe should be opened and steam from the boiler allowed to pass through the coils; the reducing valve having previously been set at from 15 to 20 pounds. As the evaporator and the water are both cold, it will save time if the by-pass valve on the drain pipe is opened and kept open until the water within the evaporator begins to give off vapor. It can then be closed and the normal working of the trap will keep the coils free from water of condensation. The valve in the vapor pipe should be kept closed until there is a pressure of 8 or 10 pounds on the evaporator shell, when it should be slowly opened and the vapor allowed to pass into the distiller. In opening the valve in the vapor pipe, care should be exercised that it is not opened so widely that the pressure of the vapor in the shell is rapidly reduced. Inattention to this precaution is almost certain to cause priming and the production of salt water instead of fresh water at the distiller.

The water from the distiller, when the evaporator is first started, usually shows the presence of salt and should therefore be allowed to run into the bilges, or, preferably, into the hot well, as it has, undoubtedly, less salt in it than the water in the boilers. This should be continued until the water, when tested with a solution of nitrate of silver ($AgNO_3$), shows perfectly clear in a glass when held up to the light. The nitrate of silver test is a very delicate one and indicates the presence of the slightest trace of the chlorides, such as common salt—sodium chloride.

When the water is clear after being tested, it should be run into the fresh-water tanks. The speed of the feed pump should now be regulated so as to maintain the water level constant, and the evaporator will run with very little attention from the engineer until the end of the watch, when it should be emptied of the concentrated brine in order to prevent salt from being deposited within the shell. It is unsafe to allow a higher degree of concentration than 5-32.

BLOWING OFF AND CLEANING.

The brine in the evaporator may be gotten out by pumping or by blowing out under pressure. Unquestionably the most convenient way is to open the bottom blow valve and permit the pressure within the evaporator to force the water out into the sea; but this method is open to the very great objection that it greatly increases the amount of scale on the heating coils. An analysis of the scale on evaporator coils shows it to be composed almost entirely of carbonate of lime, and consequently it is to the characteristics of this impurity of sea water that we must look for the explanation of the increased deposit of scale when the evaporator is blown down. Carbonate of lime begins to be precipitated at a temperature of 170 degrees Fahrenheit, and this process is complete at a temperature of 212 degrees, corresponding to a pressure of 15 pounds absolute. It is thus seen that the temperature within the evaporator is sufficiently high to precipitate the carbonate of lime. The bottom of the evaporator and the coils are covered with a soft white mud which may be easily washed out, provided it is not allowed to

become baked, as would be the case if the evaporator were emptied while it was still hot. The most approved method of removing the brine is to shut off the steam from the coils, and, while the feed pump is kept running, start the brine pump. When the evaporator has been cooled by this method the feed pump may be stopped while the brine pump empties the evaporator.

The principal ingredient of boiler scale on seagoing vessels is sulphate of lime, but of evaporator scale it is the carbonate of lime. The difference is due to the fact that only an exceedingly small proportion of the sulphate of lime that is present in sea water is precipitated until the temperature of the water is about 290 degrees, which corresponds to a pressure of 45 pounds gauge. As this pressure is never approached in the evaporator, there is comparatively little sulphate of lime deposited.

The best time for removing the concentrated brine from the evaporator is when first going on watch. It is usual for the fire-room watch to clean fires when first coming down to the fire room, and consequently the supply of steam always falls off some at that time. By emptying the evaporator at the same time, the demand for steam is reduced and thus the fluctuation in the steam pressure is lessened.

In spite of the greatest care in operating the evaporator, it is sooner or later necessary to remove the deposited scale by mechanical means. In the Davidson evaporator the entire nest of tubes is withdrawn from the evaporator and the scale knocked off by means of scaling hammers and chisel bars. The Quiggins evaporator may be scaled by removing the manhole plates in the shell and tapping the coils with a scaling hammer. The scale must afterward be removed from the bottom of the evaporator; care must always be exercised that the coils are not caused to leak.

It is always well to test the tubes of an evaporator after scaling, in order to be sure that there are no holes in them through which boiler steam can pass. The tubes may be tested by turning steam on the coils before the evaporator is closed up and passing a lighted candle along them. If there are any holes the steam issuing therefrom will at once extinguish the candle. When the evaporator is working and a leak develops in the heating coils, its presence is usually attested by the water from the distiller showing salty when tested with silver nitrate. This is caused by the violent ebullition in the vicinity of the leak. The presence of the leak is further shown by a loud, rumbling noise coming from within the evaporator, by the fact that the water in the evaporator is heated much more quickly than usual, and also by the fact that the fresh water has a peculiar "steamy" taste.

Turbines for Cunard Line.—It is reported from the other side that the British Admiralty, at the suggestion of Lord Inverclyde, has decided to join the Cunard Steamship Company in its inquiry concerning the advisability of using steam turbines for the two proposed new ships. The committee of investigation consists of Admiral Oran, deputy engineer and chief; Lieutenant-Engineer Wood, acting as secretary; Mr. J. Bain, chief manager of the Cunard Company; Mr. J. T. Milton, the engineering surveyor of Lloyd's Registry; Mr. H. Brock, of Denny's; Mr. Andrew Lang, of the Wallsend; and Mr. T. Bell, of Clydebank Works.

Coaching Steam Launch Moguntia with Petroleum Fuel.*

In May, 1902, under the auspices of the Mainzer Rowing Association, a steam coaching launch was placed in service, regarding the trials and performance of which more extended accounts have recently become available, and which will have the highest value for all interested in boats of this character.

The hull is constructed of galvanized steel, with a length of 36 feet, maximum width of 6.9 feet, and a maximum draft forward of 1.64 feet. Aft, where the greatest width is attained, the boat rests quite flat on the surface of the water. The displacement of the boat cleared for trial, and including fuel for 12 hours full-power run, is 3.8 tons.

The peculiar form of the boat (so-called tetraedral), according to the patents of Naval Constructor Kretschmer, of the German Navy, is entirely new and seems destined to show itself peculiarly adapted to high speed, since, under the highest speeds reached, there is no pronounced bow wave nor settling of the stern.

The trials were carried out on the Zurichsee and on the Rhine, and for a one-hour test a speed of 13.4 knots with natural draft was reached, and with forced draft a speed of 14 knots. Such speeds have scarcely before been reached by a boat of like displacement.

For the Mainzer Rowing Club it was laid down as a primary and most important requisite that the boat should be able to follow the fastest eight-oared shell without forcing the engine or without, even at the highest speeds, disturbing the oarsmen by waves or water disturbance. It was also required that the boat should be able to turn quickly and rapidly in a narrow channel and that her general maneuvering qualities should be the best possible. Slow speed, and stopping with an assured spring forward or backward on signal, were also laid down as prime requisites for the special purposes of the boat.

The water lines of the boat are almost straight, and the entrance angle at the bow is not more than half that of a boat of similar length and beam but of ordinary form. The sharp angle of the water lines and the straight lead of the lines along the entire boat determine the small wave formation and the small loss of power, due to the fact that the stream lines are not required, as in the more common form, to follow a line of continuously changing direction. Under the flat, broad run of the boat at the stern the run of the water to the propeller is entirely free and undisturbed. The turning power and operation of the rudder is, due to the absence of the deadwood, especially energetic, and the boat is thereby able to turn in a circle of some two boat lengths.

The boat also backs especially well, and obeys the rudder like a side-wheel steamer; while, for boats of the ordinary form, the action of the propeller in backing usually causes a deviation from the desired course. In spite of the great sharpness of the water lines, the boat, with its 36 feet length, has a maximum breadth of 6.9 feet, greater than would be possible with such a boat of the ordinary form of like sharpness, and a considerable increase of water-line area is thereby

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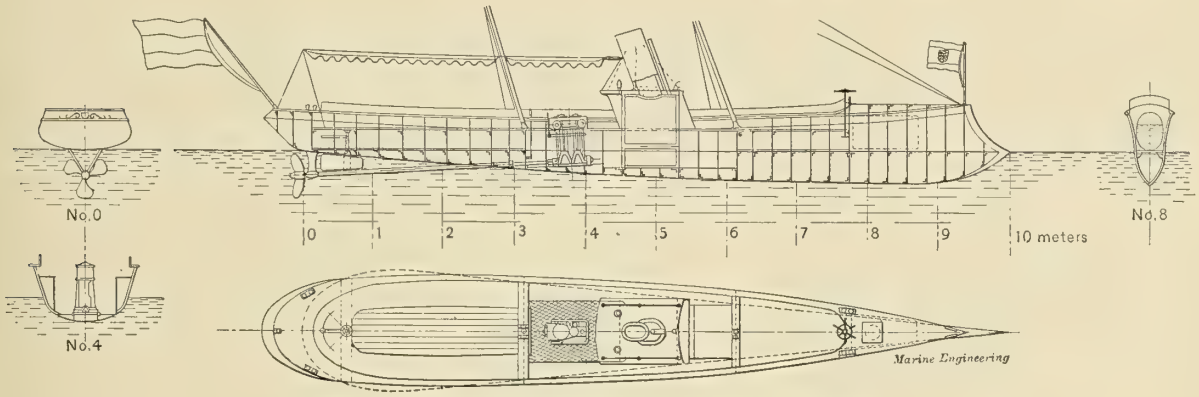
* Translated for Marine Engineering from *Zeitschrift des Mitteleuropäischen Motorwagen Verein.*

realized. This naturally gives for so small a craft a most unusual degree of stability. This again makes possible the provision of a wide, roomy space for coaches and passengers. Again, through the great breadth of the after body, the boat has been shown to possess a very satisfactory stiffness and reserve displacement, even under the powerful side thrust of the rudder when executing a sharp turn, under the full power of about 35 I. H. P. Due to the peculiarities of form, furthermore, even at the highest speeds there is manifest no disturbance to the crews in rowing, and, especially in smooth water, but the slightest lifting of the bow. The need which often exists with boats of the usual form, of using bilge or rolling keels in order to give sufficient steadiness in rough water, was here entirely absent. The stem is given a sharp slope aft, thus forming a ram bow. This is in order to give to the deck lines and to the form above water greater fullness of form, so that in rough water there would be provided a sufficient reserve displacement forward,



A GERMAN STEAM LAUNCH, PETROLEUM FUEL, USED FOR COACHING.

and the fuel-oil tanks and heavy anchor gear here located would be given ample support. The upper forward deck is of galvanized steel, well elevated, and given the rounded form of a whaleback. The space for passengers or coaches is furthermore protected by an ample washboard extending around the cockpit and above the deck level.

The motive power consists of a steam engine, compound system, with automatic lubrication. The boiler feed, and the supply of fuel in the form of petroleum oil, are both likewise automatic. The regulation and manipulation of the engine are carried out by the usual regulating gear in the simplest possible fashion. The relatively small boiler is of a special patented system, with easily removable copper tubes, so that a degree of safety and simplicity is attained hitherto scarcely possible of realization under like conditions. The combustion in the furnaces is so complete and well regulated that a noiseless, odorless flame is produced, susceptible of control to meet all conditions. The arrangement of the grate is such, furthermore, that in a short time it may be adapted for the use of wood, coal, or coke, as occasion might arise. The boiler may be fired up and full steam raised in 12 to 15 minutes, and then the engine, with its automatic features, is ready for use with but slight further attention.

The construction of the hull of the boat, notwithstanding the lightness of scantling, is very strong and stiff, and even under full steam no vibrations whatever are perceptible. It was especially important, in the construction of the boat, to give ample strength and solidity to the phosphor-bronze shaft bearings and supports under the stern, since vibration due to weakness in this important structural feature might bring into question the results of this first example of the "tetraedral" form of under-water body for ships. The design was, therefore, most carefully arranged so as to provide for a substantially continuous and connected structure, from the engine foundation to the propeller, along the flat bottom of the after body of the boat. If such part of the structure is not made sufficiently strong at first, later stiffening is usually of slight avail. With the flat after-body form of the "tetraedral" model it is a most important requirement that this part of the structure be made as light and at the same time as strong and stiff as possible. Furthermore, the center of gravity of the ship, together with the machinery, must be most carefully computed by the constructor, in order that the boat may have the proper and desired trim.

This craft, so successfully built by Escher, Wyss and Company, Zurich, may be properly considered as a most notable advance in the field of high-speed craft for sport and pleasure.

Quarterly Shipbuilding Returns.—The Bureau of Navigation reports 310 sail and steam vessels of 66,023 gross tons built in the United States and officially numbered during the quarter ended September 30, 1903. During the corresponding quarter ended September 30, 1902, 348 sail and steam vessels of 103,421 gross tons were built in the United States and officially numbered. The wooden sail tonnage decreased from 24,410 to 12,437 gross tons, while the wooden steam tonnage showed an increase from 7,769 tons to 13,729 tons. The falling off in steel sail tonnage is most marked. In 1902 for this quarter there were built two vessels of 5,258 gross tons, while this year there was but one of 3,248 tons. The tonnage of steam steel vessels has shrunk from 65,948 to 36,609, there being a shrinkage on the Atlantic and Gulf coast of from 37,306 tons to 2,208 tons, while on the Lakes there was a slight increase. No steel vessels were registered as built on Western rivers during this quarter.

THE SHIPPING QUESTION.

Desiring to secure opinions on the most suitable methods for restoring our prestige on the high seas, a prestige which, while once glorious, is now disgraced, Marine Engineering wrote to men prominent in the shipping and shipbuilding industries throughout the United States, asking for an expression of their opinion on this subject. From the many letters received, the preponderance of opinion is in favor of discriminating duties, and the following selections from the letters have been made as expressing the general sentiment.

No. 1.—*Great Northern Railway Company, New York, N. Y.*

Replying to your recent letter, I beg to say that the first thing necessary to build up the American merchant marine is to create a desire on the part of American merchants or capitalists to invest their money in ships. On the Great Lakes there is abundant business for ships, and the commercial necessities have created the demand. On the high seas experience has shown entirely different results. It is my judgment that no bonus or government aid will create an American merchant marine in opposition to those of foreign countries. Until the whole question is intelligently considered, and the conditions under which American ships meet those of foreign countries are made more nearly equal, there will be no success in building up the American merchant marine.

The United States has built up a system of railway transportation under which the public is served at an average of one-half the rates charged in Europe for like service, and this is done while wages are very much higher.

James J. Hill.

No. 2.—*The Delaware River Iron Shipbuilding and Engine Works, Chester, Pa.*

Replying to your inquiry, I believe that the merchant marine of the United States is entitled to the same protection that our other industries are; these industries are protected by tariff, and if something could be devised to give American ships an advantage in the American sea trade, the result would be an important increase and revival of interest in our shipping.

I think that probably the best plan that could be devised is the one of preferential duties, or a rebate of goods carried in American bottoms. This was done in the early days when American ships carried 80 or 90 per cent. of our shipments; and I believe that some similar plan which would not involve us in commercial wars with other powers would work out very satisfactorily in the present emergency.

The extension of our navigation laws to the Philippine islands would also be a step which would result in important increases in our carrying trade. No other power could object to the regulation which already is in force between coastwise ports; and as the Philippine islands are a part of our territory, there is no reason why the same laws should not apply to them. This would give us at once a large and profitable trade, and be the means of employing many American sailors and American ships. If we are to have any general industrial depression, the question of finding employment for our people will be an important one, and the greatest opportunity now open in this direction is on the sea.

John B. Roach, President.

No. 3.—*The Harlan and Hollingsworth Company, Wilmington, Del.*

In reply to your letter relative to steps to be taken toward building up the merchant marine of the United States, I write to say that, having had experience in the management of ships sailing under foreign and American flags, in my judgment the only way to assist to build up the American merchant marine is by direct subsidy. American owners cannot operate vessels with a handicap of 75 per cent. more wages to officers and crews manning these vessels, which is about the prevailing rate at present, unless the government will reimburse the owners to this extent.

There should also be a bounty tax paid to the builders for tonnage for the foreign trade, so as to put the prime cost of such vessels on an equality with the foreigners.

David C. Reid, President.

No. 4.—*Eastern Shipbuilding Company, New London, Conn.*

Replying to your communication relative to my opinion as to what is needed to build up the merchant marine of the United States, we certainly need assistance in some form to put us on an equal footing with the rest of the world; but, in whatever form this may come, it should be based upon American-built vessels, as it would be much better to let matters remain as they are than to pass any bill that would subsidize or admit to American registry foreign-built vessels.

Certain people have made it appear that the various ship-subsidy bills offered at different times have been for the interest of American shipbuilders and the building up of the merchant marine. In my mind, there never was a statement further from the truth; and I believe if any of the bills, previous to the one before the last Congress, had been enacted in law, the shipbuilding interests of this country would have been ruined for years to come. The shipbuilders of this country at the present time are in a most demoralized condition. This is owing to various causes, principally the increased cost of material, the increased cost and unrest of labor, and the inability of the builders of this country to compete successfully for tonnage in the foreign trade.

I believe that a subsidy bill should be based upon the amount of our exports (per tons carried per mile), and thereby the benefits would reach the farmer and all kinds of business.

Most every one is aware of the strides Germany has made in shipbuilding within the last few years. Some ten years ago Great Britain built ships for the Germans at a price equal to about 70 per cent. of that required by German builders. Now the Germans take orders in direct competition with the British, and are building equal, if not superior, vessels.

If some of our subsidy bills had been enacted in law, Great Britain would have been able—and, no doubt, pleased—to dispose of many of her old, slow, and obsolete vessels to this country, and replace same with modern, rapid, and up-to-date vessels; and it is easy

to see the disadvantages we would be under if we should obtain these obsolete vessels. Great Britain and Germany, having superior vessels, would, of course, have the preference of both freight and passenger traffic.

Steel material entering into the construction of a vessel (providing this vessel is engaged in foreign trade) is now admitted free of duty. It would be quite beneficial to the shipbuilding industry of this country to have this extended so it would apply to vessels for the domestic as well as foreign trade.

It seems to me that protective duty on steel material is not needed, as our steel manufacturers are more than able to successfully compete with the British, and have sold steel in England in the past for about two-thirds the price that they then asked for it in this country. The public press, within the last few months, has shown that steel can be produced much cheaper in this country than in Great Britain. What we need is a subsidy bill which will give a small bounty on our exports, based upon tons of freight per mile carried in American-built vessels, and, to further assist, remove the duty upon steel and coal. I am a protectionist, but believe, when an article can be produced in this country cheaper than it can be elsewhere, that it is inconsistent to have a protective duty governing same.

C. R. HANSCOM, President.

No. 5.—*Fore River Ship and Engine Company, Quincy, Mass.*

You ask me to state "as specifically as possible what action, in my mind, is most necessary to give the United States a merchant marine in keeping with its dignity and commercial importance."

I heartily agree with you as to the vital importance of doing something at once to build up our merchant marine. We must acknowledge with humiliation that our great nation has been whipped from the high seas by the superior foresight of other governments; and for this reason there are not in America to-day enough shipyards for skilled shipbuilding workmen to build the ships that are needed for the United States Navy with anything like the speed necessary, nor enough American sailors to man them when they are built.

The cause of this is evident enough; for, suppose any one of our industries protected by tariff should be exposed to foreign competition by repeal of the duty on its product, that industry would be wiped out in short order, and other industries connected with the vanishing industry would suffer also.

Furthermore, if, in addition to our lack of protection of such industry by tariff, a foreign government desired to encourage that particular industry and should subsidize it, the case of our unprotected industry would be absolutely hopeless.

This is the condition to-day of American shipbuilding and American shipowning. The building and operating of deep-sea vessels are unprotected industries which are obliged to pay the wages of our highly-protected country; and, in addition to this lack of protection, these shipping industries are and have been struggling against foreign competitors who are made strong by government help. The wonder is, not that shipbuilding and our merchant marine are at such a low ebb, but that there is anything left of them.

Coastwise ship building and owning is protected and fairly prosperous, but the busy lines of traffic in our country run east and west, and our north and south coast lines are not in line with this great current; besides this, the "maritime habit" is broken in the United States by long years of adversity; American labor is not being educated along this line; capital, discouraged and driven from the deep sea, is not attracted to coastwise shipping investments; and the shipyards on our seacoasts, though few in number, supply more building capacity than the coastwise trade can find use for, and so are obliged to depend on the uncertain business of building naval vessels to keep them going.

As to the remedy, unless Yankee ingenuity can find some method that has not yet been suggested, we must use the same weapons that England has used to drive us off the sea, *i.e.*, government encouragement. This must come through discriminating duties or subsidies; and, in my opinion, a wise combination of both duty and subsidy is needed to bring that immediate and rapid improvement that the acuteness of the situation demands.

THOMAS A. WATSON, President.

No. 6.—*The Johnson Iron Works, New Orleans, La.*

In reply to your letter inviting expression of my views on the question of "building up our merchant marine," I beg to say that advisory comment upon the problem, to have any value, should be based upon a much more profound knowledge of its factors than I possess; but even a layman would recognize that, so long as the cost of a fully-equipped steamer or sailing vessel plays important part in figuring the results of its operation, the country building the cheapest ships, other things being equal, will own and operate the largest marine fleet, where competition is on a commercial basis free from government aid.

We cannot build ships in this country as cheaply as is done abroad, owing to the cost of labor employed in the home industry; nor is it practicable, in my opinion, to ever obtain the skilled and common labor used in shipbuilding in this country at a parity as to cost in foreign countries; nor is it desirable, even if possible of accomplishment.

It may then be accepted as a substantial fact that the most energetic and enterprising people of the age are behind their foreign neighbors in the ownership and operation of so important a thing as a merchant marine, because of the comparatively excessive cost of a home-built vessel and the prohibitory governmental restrictions attached to the purchase and operation of foreign-built vessels. The shipowner is ready to increase his holdings, and others are ready to become shipowners, if an American-built vessel can be bought as cheaply as one of foreign build, or the excess in cost be made good to him by governmental warranty of profitable patronage or aid.

As it is impracticable for the home shipbuilder to compete with the foreign rival in the cost of construction, it would seem that the only remedy capable of meeting the situation must be of governmental origin. So far, a layman may logically proceed without risk

of committing grave error in review of the conditions that stand as a bar to development of our merchant marine, and so far only I dare venture.

I am not prepared to discuss the equity of the measure that would provide a government subsidy, and in this way keep the home shipbuilders from being driven to the wall; and am quite unable, under the limitations of my present knowledge, to decide whether or not the general good to the commercial interests of our whole country would be increased or decreased by removal of the restrictions attached to foreign-built vessels.

Lewis Johnson, President.

No. 7.—*Moran Bros. Company, Seattle, Wash.*

Replying to your inquiry, I believe it is high time the press of this country stated the facts to the people. The American ship and its foreign trade is too broad and patriotic a question to be used as a football by political parties, as has been done in the past. The people are not informed of the facts; certainly, if they were, there could be no conscientious difference of opinion that some plan must be devised to put the American ship on an equal basis with the foreign vessel, if we are to compete for our share of that trade with the United States, the greatest producing nation in the world and standing sixth in the foreign carrying trade. No further argument should be necessary; and, as I have said before, the wonder to me is that there can be any opposition.

The products of the Pacific coast states are to-day carried from our shores by foreign vessels under heavy subsidies, with the further advantage of the lowest operating expenses by means of the lower wages paid the crews. It is a business impossibility for American capital to compete, and the present condition of our foreign shipping should be conclusive evidence of this.

Robert Moran, President.

No. 8.—*Mexican-American Steamship Company, New Orleans, La.*

I have your letter relative to upbuilding American shipping, which I have read with a great deal of interest. I agree with you that it is a momentous question, which should receive the serious consideration of our government; and in our opinion the only way a successful merchant marine can be built up is for the government to guarantee owners against loss, either for a certain length of time or until lines to different trades could be securely established. This could be done by subsidy, either blanket or to be paid upon examination of the owners' books, as the different trades would require different consideration.

The expense in connection with United States ships is so great that I do not believe that owners would build; nor would the United States companies charter United States ships without encouragement in line with the above.

A. L. Roby, Vice-President and Manager.

No. 9.—*United States Standard Register of Shipping, New York, N. Y.*

I duly received your recent favor, but have been unable to give adequate consideration to your inquiry until this time. I am certainly very much interested in the question of building up the merchant marine of the United States, and would be in favor of any feasible measure that may be proposed to that end. I believe that in deciding upon such a measure, the organizations you mention as having the question under investigation should keep in mind that it is not the most desirable that should be urged, but that having the best prospects of adoption. In view of the fate of the bill offered at the last session of Congress, the prospect of the passage of a general subsidy measure does not seem encouraging. My opinion is that, instead of attempting to secure the united support of a particular interest, a measure should be offered having features of direct general advantage that would commend it to all fair-minded men. These features, I believe, should be:

(1) Direct mail communication, under the American flag, with all countries with which we have, or expect to have, important commercial relations, wherever that is commercially desirable. It certainly cannot help our commerce, for instance, to have our mail to South America go "via Southampton" or by tramp steamer.

(2) That all vessels receiving government aid should be so constructed as to be available as auxiliary cruisers, army transports, supply ships, etc., in time of war, and placed by agreement on specified terms at the government's disposition in such contingency.

Under such conditions it may fairly be said that the government payments to such ships would be made for value received. I would suggest, roughly, that payment should be made, on voyages between American and foreign ports, per miles run on steamers of, say, not less than 13 knots speed, the rate of payment to be increased as the speed of vessel is increased, an additional payment to be made to vessels carrying the mails under contract on specified routes.

I believe the agreement made by the British government with the Cunard line will act as a spur upon Congress, if its real meaning is properly insisted upon. That measure is certainly a most arrogant and peremptory order to us not to meddle with the North Atlantic trade in any shape or manner. I do not believe the American people will consent to be so unmercifully snubbed. As you have asked my opinion, I would submit this, but only as a most general suggestion.

Sinclair Stuart, Surveyor.

No. 10.—*Philadelphia.*

Your communication has just been submitted to me. I am glad that Marine Engineering is taking an active interest in the upbuilding of the American merchant marine, for the condition of our country as regards its merchant marine in the foreign trade is deplorable. I must ask you, however, to relieve me from writing or saying anything for publication.

If Congress is to be aroused to action, it must be by the agitation of citizens who are only interested from a public spirit. Everything written or said by those who are engaged in the business is looked upon as inspired by self-interest.

There is no doubt that public attention is more widely attracted to the subject now than ever before.

Clement C. Griscom.

No. 11.—*John S. Emery and Company, Inc., Boston, Mass.*

In reply to your letter asking our opinion as to the action on the part of Congress as to what is most

necessary to build up the American merchant marine, we would say that we hardly know how to answer you on this subject.

We have been trying, with others, for years to make members of Congress realize that something should be done to save what little American tonnage we had in the foreign trade, but we are free to say that we think the time has passed when anything can be done to save this line of trade. If something had been done fifteen or twenty years ago, this trade would not have been lost entirely; but the conditions have been growing worse and worse, until now we are free to say that we see little hope of building up the American merchant marine in the foreign trade.

In the first place, so little interest has been taken by Congress that foreigners have been constantly increasing their tonnage, and to-day there is a surplus of foreign tonnage, and the consequence is that freights have declined to such a point that, if American shipowners were given ships free of cost, they could not run them in the foreign trade, and pay insurance, and leave any profit for depreciation and interest in competition with foreign ships.

Since the death of Congressman Dingley, of Maine, who was the best friend, except Senator Frye, that American shipowners ever had in Congress, things have been going from bad to worse, and laws have passed Congress in the interest of sailors and sailors' unions, to the detriment of shipowners; so that it costs still more than ever before to victual and man American vessels, in comparison with foreign vessels.

American shipowners are always noted for feeding their crews better than any other nation, but the present scale of provisions for American merchant vessels is far in excess of that in the American or English navy, or any foreign merchant vessel, and the laws for shipping the seamen in American vessels are made very exacting for shipowners and allow the sailors to desert at will in most any port without redress to the shipowners.

With our excellent system of lighthouses and light-vessels, vessels of all nationalities come to our country and have the advantage of them free of charge, while if an American vessel goes into their ports it pays heavily for light dues and other charges.

If a law could be passed with a discriminating duty in favor of merchandise imported in American bottoms, it would be a help to American vessels; but it would be a long time before even this would warrant the building of more vessels under the American flag for the foreign trade, in our opinion.

Daniel S. Emery, President.

While our foreign carrying trade has been gradually slipping away, since the time of the repeal of discriminating duties over half a century ago, those interested in shipping have failed to secure any political redress or assistance from Congress, because of many reasons. In the first place, the shipping question has become, most unfortunately, the subject of politics of both the great political parties. Again, the inability of those interested to unite on one proposition has stood in the way of legislation. Those favoring subsidies have been almost as much opposed to discriminating duties as to free ships. Any number of remedies have been proposed, each antagonistic to the other. All this time our foreign tonnage has been dwindling, until now, when there is but a remnant left, a general cry of alarm has gone out, and the entire country is becoming interested. The first steps, consisting of a campaign of education, have met with success; the press throughout the country is taking up the issue, and, with scarcely an exception, all those who have given opinions assert the necessity of some immediate action. Several movements have been undertaken in this direction, notably by the New York Board of Trade and Transportation, and the Home Market Club of Boston. Interest, however, is not alone confined to the seaboard cities; chambers of commerce throughout the country are considering means to resuscitate our shipping.

A brief statement of the present condition of affairs may be of help. The value of our total foreign commerce for 1902 was two and one-third billion dollars; of the tonnage which was engaged in transporting this, only 873,000 tons, or 8.8 per cent., flew the American flag. Our coastwise commerce has in the meantime increased, until now the registered tonnage amounts to nearly five million gross tons. In comparison with these two figures—one of the foreign commerce, unprotected, but with an immense field to draw upon; the other of our coastwise trade, which, through the wise provision of the law, is restricted only to American-built vessels—is, indeed, a most striking comment on the efficacy of the two systems.

To regain a trade after it is once lost is indeed a much more difficult problem than to retain one already secured; and, although we at one time transported over 90 per cent. of our foreign commerce, especially favorable conditions must arise before we can in any way regain our prestige. Last year the foreign tonnage actually decreased six thousand tons, and not a deep-sea ship has been ordered for two years. With shipyards closing along the coast because of lack of work, and the few remaining American vessels being displaced in the carrying trade, it takes no argument to convince one of the alarming conditions that confront us.

Our ships cost more than foreign-built vessels, although for the last few years all material entering into the construction of vessels intended for deep-sea commerce has been admitted free of duty, but the importation of material has not been found to be satisfactory; wages paid for American shipyard labor are much higher than those abroad. Then, again, the operating expenses of vessels flying the American flag are very much more than on foreign vessels. In the first place, we pay the officers and crew higher wages; must give the crew larger quarters, and feed them better food. It would be no advantage for owners of foreign vessels to enroll their ships under American registry, because nothing would be gained and operating expenses would be much higher. Foreign governments consider the maintenance of a first-class merchant marine as necessary to their welfare, and are pursuing a policy of heavily subsidizing their vessels, which may be called upon for important service in time of war. Under these conditions it is absolutely impossible for the American ship to successfully compete.

Besides these generally known disadvantages, the American ship is handicapped from the first because of the surveyors' discriminations. It is a most natural

thing for foreign registration societies to discriminate in favor of vessels of their own nationality, and it is not to be wondered at that they will give a home-made vessel higher rating. Again, the rating assures the foreign vessel the preference in the matter of insurance, and this may be the deciding element in a vessel's earning capacity in any given trade. While nominally the fleets of Europe are unprotected, yet they are, in fact, more carefully guarded and subsidized than are any of our industries from foreign competition. While there is protection for practically every manufacturer in this country, the American ship is unprotected, although its first cost is more, and by law the owner must pay more for running it. The argument that governmental funds should not be appropriated to increase the trade of any one class of people, is one which has been heard in opposition to practically every form of tariff legislation or reciprocity. The fact remains, however, that practically all the successful industries have been built up through protection.

In letter No. 1, Mr. James J. Hill states: "It is my judgment that no bonus or government aid would create an American merchant marine in opposition to those of foreign countries"; and also: "The United States has built up a system of railway transportation, under which the public is served on an average of one-half the rates charged in Europe for like service, and this is done while wages are very much higher." It should be recalled, in this connection, that the transcontinental railways would not have been built had not the government deeded to them immense tracts of land lying along proposed roads. The resulting benefits to the whole country from the construction of these roads, and thus making possible the development of the enormously fertile plains of the West, are appreciated by all; yet this would not have been possible if the roads had not had government assistance.

In 1848, at the time when our ships were sailing every sea, the English economist, David Ricardo, said in Parliament: "It was a singular circumstance that, although the American vessels were the dearest-built and dearest-manned ships of the world, they had two-thirds of the whole trade between this country (Great Britain) and the United States; while the Russians, which were the cheapest ships in the world, were obliged to give us the whole trade between their country and ours." This was at the time when the policy of discriminating duties, sanctioned by Washington, Jefferson, and Madison, had built up our great fleets.

Other reasons which have affected shipbuilding today are caused by two opposing elements, the labor union and the capitalist. As a result of the strikes along the seaboard, shipyards have been seriously crippled, and at a time when the business did not warrant the advance of wages. A yard which was two years ago in a prosperous condition has actually closed down because of the continuation of strikes, and it is the boast of the labor leaders that they forced the owner into bankruptcy because he would not comply with their demands. How it is possible for men to be so short-sighted as to believe they are helping the cause of labor by ruining the employer, it is impossible to see. On the other hand, the exposures now being made public of the methods of organizing the Shipbuilding Trust show a condition of incompetency, treachery, and intention to defraud the public by men who had been considered capable leaders, such as to sicken the investor and place a ban on shipbuilding in the eyes of many people. These two conditions, however, are not at the root of the trouble, but have followed in the footsteps of the general depression in shipbuilding.

Discriminating duties seem to present less difficulties in the path of legislation, and, in our opinion, are more just than the subsidy system, which is possible of being operated in a partisan method. A reduction of, say, 10 per cent. of the duties on goods imported in American bottoms would provide the necessary stimulus and protection to start up shipbuilding. Under this system our foreign tonnage was rapidly built up, and we quickly assumed a leading position as a maritime nation; a return to this system should produce similar results.

Meeting of the Society of Naval Architects and Marine Engineers.

The eleventh general meeting of the Society of Naval Architects and Marine Engineers will take place in New York, N. Y., at 10 A.M. Thursday, November 19, 1903, at the rooms of the American Society of Mechanical Engineers, 12 West 31st street. The session will continue through Thursday and Friday. On Friday evening, the 20th, at 7 o'clock, the annual banquet will be held. Members intending to propose candidates for membership can secure blank application forms by addressing the secretary. All applications should be returned to the secretary on or before November 17. A list of the papers to be read is as follows:

THURSDAY, NOVEMBER 19, 1903.

1. Progressive Trial of Ferryboat *Bremen*. By Col. Edwin A. Stevens, Vice-President.
2. The Isthmian Canal. By Civil Engineer A. G. Menocal, U. S. N. (retired).
3. Notes on the Arrangement and Construction of Steam Pipes and their Connections. By R. C. Monteagle, member.
4. Gasoline Engines for Marine Propulsion. By D. H. Cox, member.
5. Some Thoughts on the Design of Modern Steam Yachts. By Clinton H. Crane, associate.
6. Water-tight Subdivision of Warships. By Commander Wm. Hovgaard, Royal Danish Navy, member.
7. Non-corrosive Nickel-steel Boiler Tubes. By Albert Ladd Colby, Esq.
8. Curves of Form of the Initial Condition. By George C. Cook, member.

FRIDAY, NOVEMBER 20, 1903.

9. The Metric System in Relation to the Shipbuilding Industry of the United States. By Naval Constructor J. H. Linnard, U. S. N., member.
10. Electricity in Manufacturing Plants. By W. M. McFarland, member of council.
11. Description of the Design and Building of the 21,000-ton Steamships *Minnesota* and *Dakota*. By Charles R. Hanscom, member.
12. Ships' Forms Derived by Formulæ. By Naval Constructor D. W. Taylor, U. S. N., member of council.
13. Some Notes on the Performance of the Torpedo Vessels of the U. S. Navy at Sea. By Lieut. L. H. Chandler, U. S. N., associate.
14. Notes on the Launching of the Cruiser *Chattanooga*. By M. S. Chace, member.
15. Notes on Side Launchings. By Assistant Naval Constructor W. G. Groesbeck, U. S. N., member.
16. Launching of Large Merchant Vessels. By W. A. Fairburn, member.
17. Displacement and Stability Calculations. By Professor W. S. Leland, member.
18. Graphic Calculations of a Ship's Stability. By Prof. M. H. Bauer, member.

CHARLES W. RAE, RECENTLY APPOINTED ENGINEER-IN-CHIEF OF THE UNITED STATES NAVY.

Mr. Rae, the subject of this sketch, is well known among naval engineers because of his strong personality and fine professional record. Mr. Rae was born at Hartford, Conn., June 30, 1847, and is a son of the late Rev. Luzern Rae. His inclination led him to the study of marine engineering, and he entered the Polytechnic Institute, Troy, N. Y., from which college he graduated with the degree of civil engineer in the class of 1866. He then attended the United States Naval Academy, Annapolis, Md., and was in the class of 1868, which was the first year in which engineers were ever graduated from that institution. He was on sea duty following graduation and served on many of our warships and on all stations except the Asiatic.

At the time of the first consideration of the transisthmian canal Mr. Rae was a member of the Tehuantepec and Nicaragua Canal surveying expedition during the years 1869-71, and had charge of the line of levels in the field and of the resultant work in the office. In his shore duty he was assigned to stations requiring hard work. In 1874-78 he was instructor at the United States Naval Academy, and in 1893-97 he was head of the department of steam engineering in that institution. In the latter year he was appointed member of the board presided over by President Roosevelt, then Assistant Secretary of the Navy, which was commonly called the "Personnel Board," which recommended the amalgamation of the line and engineering corps. Admiral Sampson, at that time captain of the battleship *Iowa,* was also a member of the board. He has also served in the office of Naval Intelligence and in the Bureau of Steam Engineering, Washington. Throughout the war with Spain he was chief engineer of the battleship *Iowa,* which was engaged in the bombardment of San Juan, Porto Rico, and in several bombardments of the defences at the entrance to the harbor of Santiago de Cuba, and finally in the destruction of Cervera's fleet.

In the words of the Navy Department, "for his eminent and conspicuous conduct in battle" Chief Engineer Rae was advanced three numbers in rank and received the medal for the campaign in the West Indies. At the time he was appointed Engineer-in-Chief of the Navy and Chief of the Bureau of Steam Engineering, Mr. Rae was on duty as a member of the board for the examination of officers for promotion, and technical examiner for the United States Civil Service Commission. Rear-Admiral Rae, which title he now bears, enters upon his very arduous work with the respect and cooperation of the entire service.

REAR-ADMIRAL CHARLES W. RAE, ENGINEER-IN-CHIEF, UNITED STATES NAVY.

Erratum.—The article entitled "Internal Lubrication for Marine Machinery," which was published in the October number of Marine Engineering, was written by Mr. H. C. Dinger, Lieutenant, U. S. N. The name was misspelled.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

THE approaching meeting of the Society of Naval Architects and Marine Engineers should be an occasion of great interest and importance to the shipbuilding interests of the country and to those who are concerned in them. The lines of natural activity for such a society lie within scientific and engineering boundaries, and within such limits its powers for good to the industry at large are great. It serves to bring together representatives of various branches and from various sections of the country, and gives opportunity for personal contact and for a ready interchange of ideas, which is certainly of the highest value to all who may be able to attend. This opportunity for reciprocal contact between men engaged in the same field of work is perhaps of not less importance than the opportunity of hearing the reading and discussion of the papers, especially as the latter will be forthcoming later in printed form. However, it is safe to say that valuable as the opportunities for general contact may be, it is very sure that a successful meeting could scarcely be held without a good list of papers and the attendant discussion to serve as the main feature. In respect to the papers for the coming meeting, the programme, given in another column, promises well, and it is unfair to judge in advance of their actual presentation. It is perhaps not too much to say, taking the papers as a whole which have been presented during the past few years, that, good as they are, they should have been better. This is, moreover, no mere platitude. The papers do not, we are satisfied, represent the best that the members of the society can do. As an exponent to the whole world of the scientific and engineering capacity of American shipbuilders and engineers, the level is too low; and as a contribution to the world literature of the subject and to the advancement of the scientific basis of marine construction, the results are not worthy of the place which we should seek to occupy.

These remarks are not intended as a criticism on those who have presented papers before the society, except to this extent, that while there have been some contributions of the highest excellence and of permanent value, the number has not been as great as might be wished and the average result is on too low a level. This apparently springs primarily from the fact that the mode of life of those in this field of activity is too strenuous on the commercial and administrative side to allow the proper manifestation of the impulse toward scientific investigation. We refuse to believe that the talent engaged in this field is not capable of better things than we have yet seen, or, at least, more of the higher type of scientific engineering work; but the fact seems to be that we are all so occupied primarily in making money for stockholders and in the achievement of immediate results, and hence in the practice of the immediate operative branch of the art, that but small opportunity is left for pushing research into the unknown and adding to the available methods and means for carrying on the industry. We do not assume that anything which can be said in these columns will have any particular effect on the result, for it is a natural consequence of the nature of things as they exist at the present time in the United States. The reason reaches down into our national character and cannot lightly be changed. It will do us no harm, however, to recognize the situation as it is, and it certainly is to be regretted that conditions are not such as would make possible a more liberal exhibition of the natural genius which the society certainly possesses in its membership. In the meantime we

may hope for at least gradual improvement in conditions and for corresponding improvement in the number of important contributions which the transactions of our society will be able to present as its contributions to the world literature of the subject.

Space lacks for adequate reference to the discussions. Here, however, is likewise room for great improvement, conditioned, we believe, primarily on getting the advance copies of papers into the hands of the members at an earlier date. This is again dependent on the members themselves; for, if those who write will not furnish copy in time for such presentation, the management can scarcely supply the advance copies at the earlier date desired.

A further reason for the importance of the coming meeting is found in the present situation in shipbuilding; and while, as we have noted, the normal activity of the society lies along scientific and engineering lines, it may be questioned whether some part of the deliberations on the present occasion might not be well turned toward an examination of the conditions in the commercial and practical field, and of what steps might or should be taken to place matters on a more normal basis. It is, of course, true that the society has no power to change economic conditions, nor can it undertake, as a society, any active programme involving legislative or congressional action. Such action means, unfortunately, a question of politics, and by natural limitation the society is thus cut off from its proper right of initiative in what should not be primarily a question of politics at all, but rather one of economics, and calling for consideration on broad and patriotic planes. Such questions must, of course, be dealt with cautiously in the meetings of an engineering society; and while, perhaps, but slight initiative could be taken, we believe that it might do no harm if a heart-to-heart experience meeting could be held, participated in by representative builders from the various parts of the field, and that possibly some steps might be devised which would aid in bringing matters into a more satisfactory condition. In any event, the condition is one which merits the most serious attention of all interested; and whether or not any initiative can be taken by the society, the members might individually gain a better understanding of the situation, and be the better able to cope with it, each in his own particular field.

WITH this end in view we present in other columns the opinions of several men, well known in shipbuilding and shipowning, on the general conditions of these industries and remedial methods to be applied. The general opinion is in favor of discriminating duties, such as existed during the early days of the Republic, and which was one of the causes of building up our former glorious marine. So imperative is it that these two industries receive governmental consideration that we urge upon all our readers to give the subject their careful thought and impress upon their congressional representatives, either Republican or Democratic, the absolute necessity of some action being taken up by the coming extra session of Congress.

It is stated, by those who are opposed to any government assistance, that American brains and capital will invest in shipping, provided the returns are satisfactory; also that, as other countries, notably England, do not discriminate against foreign ships, we should follow the same principle. These statements are most misleading. Every foreign country with a merchant marine of large tonnage has paid the utmost attention to this question, and has seen to it that its ships were given every possible assistance, principally in the way of subsidies. The most recent and most conspicuous example of this is in the agreement between the British government and the Cunard line, in which the former has, in fact, become a partner to the company in building and maintaining a fast fleet of ships for the North Atlantic. It is an evidence to what extent the British government is prepared to go to maintain supremacy on the seas. It is against these highly favored lines under government patronage that our vessels must compete. In the first place, our ships cost more, the wages paid to all of the crew are much higher than those for foreign vessels, and the food and accommodations for the crew must be better. In the face of these conditions can it be expected that our ships can enter in the foreign trade? The greater wonder is that there is still a vestige of American ships left. It is estimated that over one hundred million dollars are paid annually to foreign companies for the transportation of passengers, mails, and freights. This amount largely offsets the balance of trade and increased prosperity which our country would otherwise enjoy. We trust that Congress will see the seriousness of the situation and will enact suitable legislation.

The Skipper's Turbine.

BY E. A. BLACKWELL.

During the early part of the '90s I was connected with a machine shop in one of our Eastern seaboard towns that did considerable marine repair work. We had a good pair of shears, and a good slip and pier in the rear of our shop where tugs and yachts drawing up to 14 feet could lay up while repairs were being effected. We also had a very good lot of tools, and we could handle almost any job that offered, especially repair work. Our work was mostly on tugs and yachts, and, as it was always satisfactory, many of these craft returned with work for us from time to time, and so I made many acquaintances with the captains and engineers.

Among my acquaintances thus formed was a jovial old captain, on whom his seventy years of life sat very lightly, considering that more than fifty of these had been spent upon salt water. The "Skipper," as we always called Captain W——, was a man of large and commanding figure, standing nearly 6 feet 3 inches high. His snow-white hair and the peculiar sailorly cut of his beard made him look a perfect type of the old-time sailor.

During our acquaintance Skipper and I had many a talk. He had many "hobbies" to ride, but the principal one of these was the propulsion of ships, and he was firmly convinced that some day he would discover some means of propelling ships that would revolutionize marine engineering and turn the existing laws of hydrostatics topsy-turvy. I rather liked the old Skipper, and I often helped him in a friendly way, by sketches or otherwise, to ride his "hobbies." Among the Skipper's deficiencies was his lack of education, and especially along the lines of mathematics. One day, while standing down at the end of our pier, I saw the Skipper's tugboat come limping up to the dock under one bell. After greeting the Skipper, I found that his engineer had "melted her down" on the crank pin. The pin was found to be so badly cut that it would require filing to true it up, and, the brasses never having been babbited, I concluded to bore them out and rebabbit them while the pin was being smoothed up.

After we had his job well under way, Skipper called me into his room abaft the pilot house to unfold to me his latest scheme. "Boy," he said, "I have got her now. You know as well as I do that engines of tugboats, as they are now built, are always more or less a nuisance, due to breakdowns. They are always running hot or breaking down just when business is at its best. Now, with my pumps it is different. Take, for instance, my wrecking pump: she is always ready for work. And say, boy, I believe if I ever gave her a suction in this river I could pump the old stream dry in an hour."

I said rather mildly that I hoped he would never execute any such maneuver as that, as it would seriously inconvenience other people that used the river, as any such a move on his part would leave them, as well as himself, aground.

"Well, what I am up to now is this: I am going to take this worthless heap of scrap iron, that you call the engine, out of this boat, and leave only her boiler and her tail shaft and her propeller in. Then I am going to put in a turbine water wheel, connect this on my tail shaft, and then put in a big duplex pump, and pump water into my turbine wheel. Why, boy, I often wonder that I never thought this thing out before, because the whole thing is so simple. Now, then, you get a pencil and paper, and give me a hand to 'figger' this thing out."

I took out a sketch pad and pencil, and reamrked: "You will want as much power in your boat under the new arrangement of machinery as you have now, won't you, Skipper?"

"Yes, yes; that's the idea, boy."

"Now, your present 'conglomeration of scrap iron,' as you call your engine, is a twenty square. This would make the effective area of your piston (less one-half the area of your 3 1-2-inch rod) about 309.35 square inches; then your piston travel in feet per minute would be 20 inches × 2 × 100 revolutions = 4,000 inches ÷ 12 = 333 feet. Then we have 309.35, the effective area of the piston, × 333, the feet traveled per minute, ÷ 33.000 = 3.12 H. P. This would then be the horse-power constant for one pound mean effective pressure on your piston; and since you carry from 115 to 125 pounds boiler pressure, we will assume a mean effective pressure of 75 pounds. Then 3.12 × 75 = 234. This is the horse power of your present engine. Do you understand, Skipper?"

"Well, no, boy, I can't say that I do; but I guess she's all right, though."

"Well, now, as we have a fair estimate of our horse power developed, our next step is to find our steam consumption. As I believe your engine to be in good condition, and the piston and valve tight, we will assume a steam consumption of 30 pounds per indicated horse power per hour; then 30 × 234 = 7,020 pounds of steam consumed per hour for our engine.

"Now we will take our turbine wheel. To the best of my knowledge and belief, a good turbine wheel will only utilize from 60 to 80 per cent. of the theoretical head of the water used. We will split the difference here and say that our turbine utilizes 70 per cent. Then we will have to add 30 per cent. to the horse power of the pumps we are going to use to pump the water into our turbine. Adding 30 per cent. to our engine power would be 234 × 1.30 = 304.20. This is the horse power, then, of our pumps. A pump of this size, duplex and not compounded, would use at least 100 pounds of steam per horse power per hour. Then 304.20 × 100 = 30,420 pounds of steam consumed per hour for our pumps."

"Yes, yes, boy, I catch on; and say, you're a 'side wheeler' on 'figgers,' all right."

"Now hold on, Skipper," said I; "let us go a little further on this subject. We have now found the steam required to run the engine and the pump. Now let us look at the economy: 30,420 pounds per hour, the steam consumed by the pump, divided by 7,020 pounds, the consumption of the engine, is 4.3. This, you will plainly see, is an increase of 4.3 times your present steam consumption.

"In other words, Skipper, you will want about four more boilers the size of your present one, and I am afraid that to handle the water you would require would make the size of the pump so large that you would have to tow a pontoon alongside with the pump erected on it. This would make a rather ungainly rig, Skipper, don't you think so? Now, is there anything else I can help you with in regard to this scheme? And, while I think

of it, there is another small item I have forgotten to mention, and that is this: You will remember there is no method of reversing the motion, or direction of rotation, in a turbine water wheel, and, as you sometimes need to back, this would require *one more turbine*, with the buckets set opposite to our go-ahead wheel. This would, of course, mean a few large valves, or gates of some description, so as to change the flow of water from our go-ahead to our backing wheel."

"No! No! That will do, boy," remarked Skipper. "And say, boy, don't you say another word about turbines, but bear a hand with them brasses, as I want to get under way as soon as they are ready."

A Broken Crank Shaft on the Syracusa.

Much concern was felt over the German steamship *Syracusa*, which sailed from Victoria, Brazil, on September 5, laden with coffee, and arrived in New York ten days overdue. The delay was the result of a most unusual break to her shafting, which was replaced after the hardest kind of work.

Seven days out from port, when in a heavy sea, the crank shaft of the low-pressure cylinder broke close in the after coupling, and gave out a shower of sparks like an electric fire. The engineer in charge, who was standing near the throttle, at once closed down the engine; the propeller continued revolving for a few turns, but the engine stuck fast. The crank shaft is of solid forging, built in three interchangeable sections. It was at once evident that the repair would entail the hardest kind of work for the entire crew. The engineer's force consisted of chief and three assistants, three oilers, six firemen, and the coal trimmers. A spare shaft was stored in a recess at the forward end of the engine room, and it required special tackle to unship the old one and get the new one in place. It was found, however, that the bolt holes in the couplings of the new shaft did not correspond exactly to those of the adjoining couplings, and therefore it was necessary to ream out all the holes. There were nine in each coupling, 2 3-4 inches diameter. A special reamer had to be built, as no tools were at hand large enough to perform this heavy work. The holes were tapered, and tapered bolts fitted in. The break was a most unusual one. The shaft had been literally twisted off the coupling and the broken end was spherical, the break showing that there had been a fracture for some time, and that the last material to give way had been literally pulled apart and spun round like candy. The wrenching had pushed the thrust block loose from its foundations and bent the floor angles. Before the shaft could be lined up these angles had to be straightened, and both a fore and aft stiffener bar, between thrust and engine foundation, and a cross stiffener on top of the floor, were bolted on.

This work was done while the vessel was rolling, for the most part in heavy seas. The captain and all the deck force lent a hand below, and the work was carried on day and night. Two whole days were spent in making the necessary tools for boring, and then three days were required to bore the holes, the men working in three-hour shifts. After the spare shaft was in place, another day was required in lining up and repairing the thrust shaft and bearing. The work was all accomplished under the most difficult conditions, and Chief Engineer Sieh and his assistants deserve the highest credit for their ingenuity and perseverance.

The *Syracusa* is a schooner-rigged ship, built by the Society John Cockerill, Hoboken, Belgium, 1894. She is 1,543 net tons, 320 feet long between perpendiculars, 40 feet beam, and 27.4 feet deep. The engines are a most remarkable set of triple-expansion, three-cylinder engines, and were on exhibition at Antwerp before being placed in the steamer. The cylinders are 27, 44, and 70 inches diameter by 44 inches stroke, and the shaft is 13 inches. Almost all the parts are finished, and it is in truth a show design. Each cylinder and its steam chest is a separate casting, and they are held together at the top by horizontal wrought-iron braces. The cylinders are mounted at the back on cast-iron columns forming part of a cylindrical horizontal condenser, and at the front by wrought-iron columns. All forgings and castings appear to be of the best quality. Such care has been shown in turning out this engine that it is all the more remarkable that such a gross mistake should be made in not having the bolt holes of the spare shaft to match. This is but another case showing the absolute necessity of equipping a marine engine with the most accurately fitted spare parts. When necessary to make repairs at sea, it is invariably the case that they must be carried out under the most exacting conditions, and to subject the engineer and his force to such severe work, and at the same time endanger the total loss of the vessel and the crew, all because of carelessness in fitting a spare part, is indeed unpardonable.

J. W. H.

PERSONALS.

T. H. M. Brown, formerly general shop foreman with George Fenwick and Company, Ltd., Hong Kong, China, has now taken the position as engine draftsman with the Neafie and Levy Ship and Engine Building Company.

William Alfred Perry, who has been president of Henry R. Worthington, Incorporated, has retired from business.

John M. Dunbar, who was formerly employed in the drafting offices of the New York Shipbuilding Company and the Townsend-Downey Company, is now working his way westward. He has temporarily given up his profession, and, with a friend, is working on farms en route West.

Frederick Jenkins, formerly machinist at Nixon's Shipyard, is now machinist at the Wheeler Condenser Company.

G. M. Aitken has accepted a position in the hull drafting room of the Union Iron Works. Mr. Aitken was formerly with the Lidgerwood Manufacturing Company.

Arthur W. Goodrich, formerly ship draftsman at the Union Iron Works, has now taken the same position in the Department of Construction and Repair, Mare Island Navy Yard, Vallejo, Cal.

William H. Crawford, Jr., of San Francisco, Cal., is now associated with Charles C. Moore and Company, engineers and contractors in the same city.

Dr. Hans Goldschmidt, inventor of Thermit welding process, is coming to this country to lecture on this process early in November.

Walter S. Bickley, who for some time has been assistant superintendent of the Pennsylvania Steel Casting and Machine Company, Chester, Pa., has been made manager of the company.

C. B. Loomis, formerly with the Rock Hill Furnace, Pennsylvania, has accepted a position as mechanical draftsman of the Union Iron Works.

James McLaughlin has resigned from the Barr Pumping Engine Company, Philadelphia, Pa., where he held the office of secretary and treasurer.

Frank H. Cross, for several years connected with the Columbian Iron Works, Baltimore, Md., and the Wm. R. Trigg Company, and lately of the Siegel-Cooper Company, marine contract department, has accepted a position with the Carley Life Float Company as manager of the New York office, F 4 and 5, Produce Exchange.

Charles H. Cramp Resigns.—At a meeting of the board of directors of William Cramp and Sons' Ship and Engine Building Company, held on October 2, Charles H. Cramp tendered his resignation as president and was chosen chairman of the board—a new office. The following officers were elected: president, Henry S. Grove; vice-president, Edwin S. Cramp; general manager, R. W. Davenport; the latter was also chosen a director of the company.

The Rapid Run of the Kearsarge.

Editor Marine Engineering:

I have been interested in the account in your September issue of the remarkable run of the *Kearsarge* across the Atlantic, particularly as it affords you an opportunity for comparing the runs of the *Columbia* over the same course some years ago, that of the *Good Hope* to Cape Town in the present year, and this run of the *Kearsarge*. May I be permitted to point out one fact which seems to bear a very important part in rendering the comparison much more favorable to the American ships than to their English cousin? In running across the Atlantic the two American boats would be able to secure for their circulating pumps, for every knot of run, water which would never have a temperature of more than 65 degrees, probably. On the other hand, the *Good Hope* would be obliged to put up with water that would average anywhere from 10 to 20 degrees warmer than this in the North Atlantic for a very large portion of her run.

I see that Kent in his handbook says, with reference to this question of condensation in the tropics: "For ships whose station is in the tropics the allowance (area of cooling surface) should be increased by 20 per cent." That is to say, then, that the *Good Hope* on her run to Cape Town was handicapped for at least two-thirds of her run by having 83 per cent. only of the condensing surface which she should have had in order to put her on an equal footing in competition with the other two.

In order to see what a handicap this means, it may be remembered that at the opening of the South African war the White Star steamship *Majestic* was chartered by the British government to transport troops with all possible speed to the Cape. On her regular route—namely, almost the very one followed by the *Columbia* and *Kearsarge*—the *Majestic* can run from port to port at very nearly 20 knots an hour; but, although pushed to her utmost capacity on her run to the Cape, so telling was that 13 per cent. discount that she barely averaged two-thirds of her North Atlantic passage time.

P. B.

We agree with the estimate of our correspondent for cooling surface on account of warm circulating water, but he has overlooked the fact that all three ships were run at reduced power, while they are fitted with condensers capable of handling the exhaust from the engine when running at full power, which on the *Good Hope* was about three times the power developed on her recent run to South Africa. We doubt not that the entire condensing surface was used on the main engines, for there is no way of cutting part of it out, even if desired. With this superabundant surface a good vacuum surely could be obtained.—Editor.

ENGINEERING SPECIALTIES.

A Star Indicator for Navigation.

Navigation has of recent years become a more exact science and the rough approximation of a ship's position at sea is no longer satisfactory, for the increased size and cost of vessels, and the many hundreds of souls on a single steamer, make it necessary that every precaution be taken to have the exact location of the ship known to the navigator at every hour of the passage.

While the improvement, in recent years, of star telescopes and binoculars has undoubtedly led to a greater use of star sights, their general use has been restricted in practical navigation, for an observer does not care to go through a lengthy longitude calculation unless he is certain of the identity of his star.

Navigators recognize the advantages of star sights for longitude in high latitudes in winter, but the question of identifying the star is a serious hindrance. Frequently after an overcast day the eastern horizon clears sufficiently for the observer to see one star, but it is impossible for him to identify it when seen alone, and thus many longitude sights are lost.

Again, as navigators are generally only familiar with stars that are named in the nautical almanac, they do not make use of many other visible stars which have no proper names assigned them. Thus there are 19 stars visible in the North Atlantic all equal to or exceeding the magnitude of Polaris, and there are 29 stars of the second magnitude of equal or greater brightness than Markab. Besides these there are 25 other stars of the second magnitude which may be used for taking observations with a daylight-illuminated horizon.

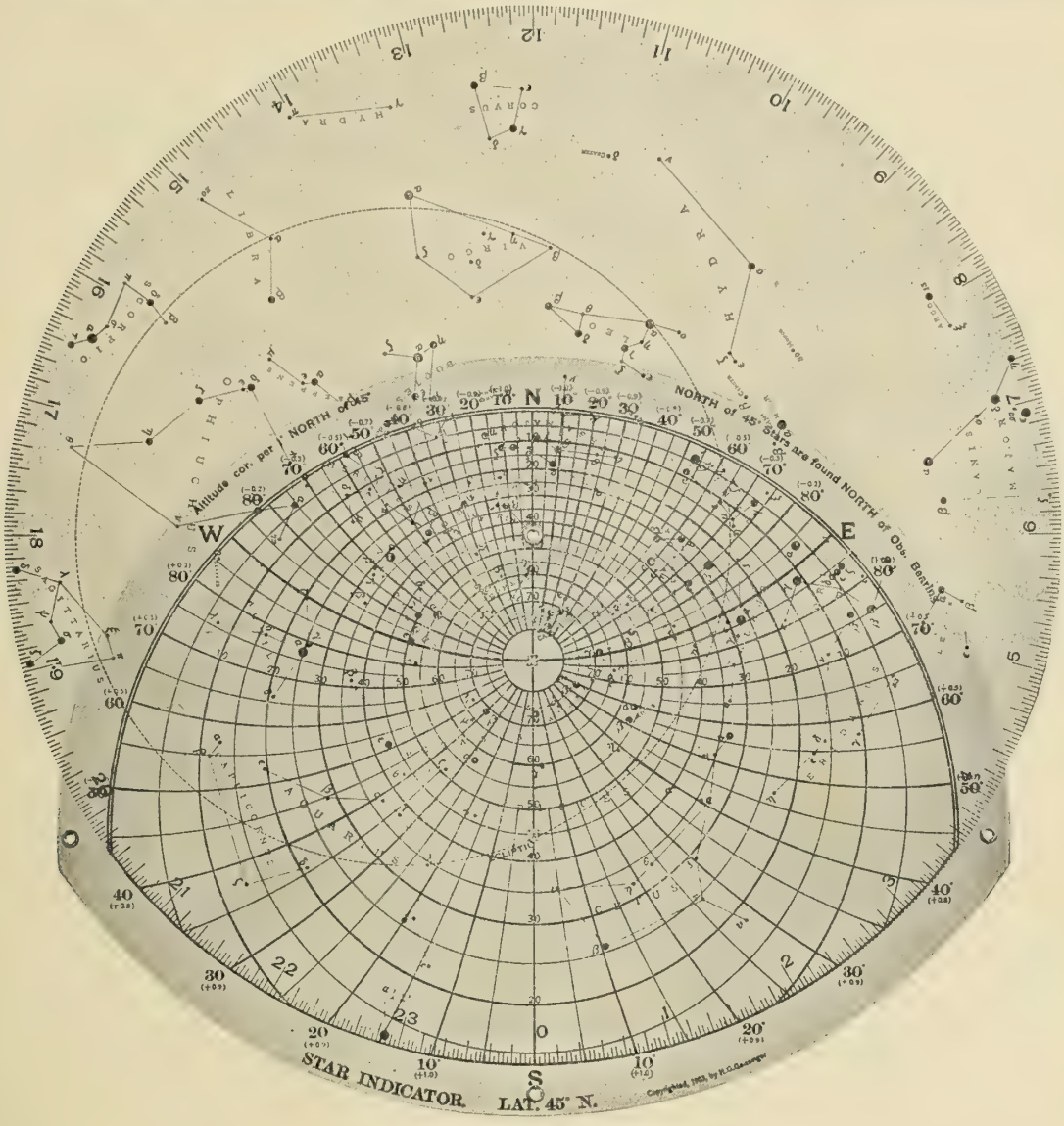
A star indicator has been recently devised and copyrighted by Dr. H. G. Geissinger, of the International Mercantile Marine Company, by which star observations may be quickly taken and with absolute certainty. The indicator, as shown in the accompanying cut, consists of a northern-star chart, 16 inches in diameter, printed upon ivory celluloid, upon which are stars of the first, second, and third magnitudes, the latter being distinct from the useful stars. The star letters are very clear and follow the style of the nautical almanac. The chart is laid out as if one were looking down upon the heavens, so that east and west bear their natural relations. There revolves about the north pole of the

chart a transparent celluloid scale, having circles of altitude from the horizon to the zenith, and lines of azimuth radiating from the zenith. When the meridian of this scale is set to the right ascension of the observer's meridian, all the stars within the horizon are seen to occupy their positions of altitude and bearing.

To find the observed star on the chart, it is only necessary to calculate the right ascension of the meridian at the time of observation (as for the correction of a pole-star sight), set the indicator to that time, and follow the observed altitude and bearing to their intersection. Having found the star taken upon the chart, the observer has only to revolve the meridian of the indicator over its center to find the star's approximate right ascension. This enables him to locate the star in the nautical almanac. He can further read off the star's declination, and as the chart gives the magnitude of the star, its letter, and its constellation, there cannot be any mistake in selecting the proper data from the almanac. Any prejudice against the use of minor stars without proper names is quite unfounded; if a star is bright enough to be picked up by the sextant, its contact with the horizon can be made more perfect than that of a brilliant star.

The identification of a star depends upon the time and altitude, and to a minor extent upon the azimuth, for it will be found that, with very few exceptions, there are no stars of first and second magnitude occupying the same altitude within 15 degrees of each other in bearing. This is therefore the only method of identifying stars wherein the bearing may be approximate. It has been found that a rough bearing, within half a point, identifies the star in almost all cases, and uncertainty for want of the exact bearing is apparent at sight.

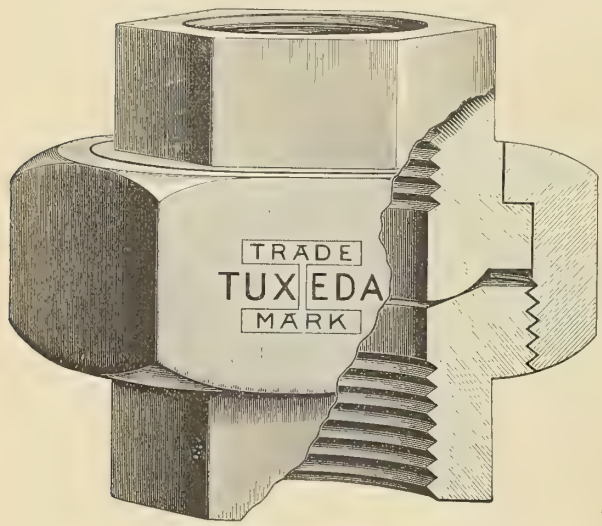
A still more important use of the indicator is that it may be set in advance for a twilight observation and thus give the altitude and azimuth of any suitable star for any given time. With this data the observer may pick up in early twilight stars which were invisible or passed over by the eye.



A NEW STAR INDICATOR FOR NAVIGATION.

The use of the star indicator thus gives the navigator the same opportunities in the use of stars for longitude as he has had in latitude, at the expense of a small and familiar calculation and a bearing taken without instruments. It inevitably opens up a more extended field of observation.

This indicator, which was thoroughly tested over a period of three years upon several ships of the Red Star line, has been pronounced a ship-shape, practical aid to navigation. It is also of great value for use in instruction in nautical schools, as stars are presented in their intelligible functions of altitude and bearings. As both chart and scale are made entirely of celluloid, they are proof against moisture and handling for an indefinite period. It is especially suited to the transatlantic routes and is available for observations taken between 35 and 55 degrees north latitude.

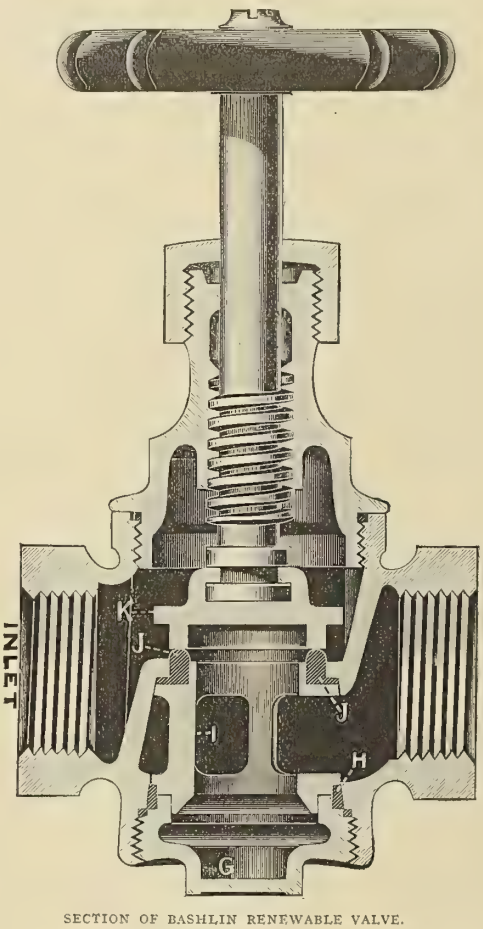


A BRONZE PIPE UNION.

A New Union.

Designing a union that will withstand severe usage, now so common in marine practice, is no simple matter. Heretofore ordinary brass round-end unions have caused so much annoyance and expense that shipbuilders and others have been forced to adopt the use of flanges. The Tuxeda bronze union, illustrated herewith, has recently been placed on the market to supersede flanges, even on brass pipe up to No. 4-inch size. While the union is made very heavy, of bronze, there is not an ounce of metal wasted. It is made with both ends hexagonal for the use of a monkey wrench. The metal at these ends is so abundant that they can be forced on to extra strong pipe without fear of spreading. Polished, they make a fine connection, the appearance or efficiency of which is not destroyed by the use of a Stillson wrench. The nut is heavy and the threads are long and accurately cut. The joint is formed almost on a straight line by a slightly tapered seat and a short-radius nose, which prevents this part from crushing down to the shoulder and insures a joint that expansion and contraction will not affect. It also enables one to bring the ends of the pipe closer in connecting, and this feature, coupled with its excessive strength, will permit of forcing a pipe into line without injury to the coupling.

Unions are easier to manipulate than a flange, and are superior to any iron pattern. When an iron flange does crack, due to a blow or from careless pulling up, there is danger to life and property. When a ship goes to sea no joint is too strong, and it is safer and more economical in the end to use pipe joints that require no packing. The Tuxeda union is owned and manufactured by Franklin Williams, 39 Cortlandt street, New York, N. Y.



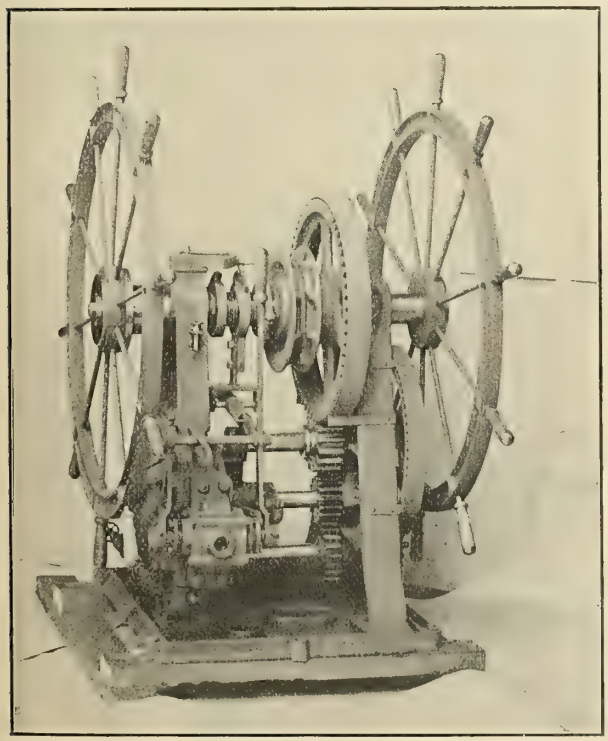
SECTION OF BASHLIN RENEWABLE VALVE.

A Renewable Valve.

Among the requirements for a first-class valve are that it shall be made of good material and the workmanship must be of the best. It must be plenty strong enough to not only withstand the steam pressure but the severe strains due to expansion of the pipe and the water hammer, etc. Above all, it must remain tight, and the parts must be interchangeable and the seats renewable.

The Bashlin valve fulfills these conditions, for it is made of the best material and by skilled workmen. All valves are carefully inspected and tested before leaving the works. By referring to the illustration, the construction of the valve will be seen. The spindle has at its lower end a gun-metal disk, *K*, which closes upon the seat ring, *J*. Guides for centering the disk prevent

rattling, increase the strength, and insure that the disk will properly close on its seat. The ring *J* rests on a post, *I*, which is inserted through the bottom and held in place by the plug *G*. All parts are made to standard gauge, and thus any part may be renewed. This is a specially desirable feature with the ring seat, which is bound to be cut and worn by the steam. When the seat is cast solid to the diaphragm, if it becomes leaky, a new valve is required. The special point of interest in this valve is that if the seat ring wears out it can be easily removed and replaced with a new one, and that while the valve is under pressure. This is made possible from the fact that there are two seats, one on top of the diaphragm and the other on the flange disk. The plug *G* is slowly unscrewed and the seat *K* screwed down at the same speed until *K* rests on the auxiliary seat of the diaphragm; then *G* and *I* may be removed and a new seat ring put in place. Another feature of this valve is that its stuffing nut also may be packed under pressure. These valves have either flanged or screwed connections, and are made by the Bashlin Company, 177 Broadway, New York, N. Y.



STEAM-STEERING ENGINE.

Compact Steam-Steering Engine.

The cut above illustrates the Dake steam steerer ready to place in a pilot house and connect to steam pipe and steering chains. It is driven by a Dake reversing engine which is backed geared to the chain-wheel shaft by double gearing, fibroid gears being used on the engine shaft, making practically a noiseless machine. The engine valve is connected to steering wheel by a lever, and the gear is stopped, started, or reversed by moving the steering wheel slightly from center to center either port or starboard.

The motor used is of the double-reciprocating, square-piston type, well adapted for direct-connected work where small, compact, and high-speed motors are desired. The working parts consist of two movable pieces, one sliding inside the other, and guided in their movement by a crank on the end of the driven shaft. The inner piston has cored through its body four ports, leading to the four sides or ends of the piston, which communicate with the two ports cut in the cover or cylinder head of the motor. The steam passes through the center and exhausts through the circular aperture; or, when the throttle is reversed, the steam is taken through the circular ring and exhausted through the center port. The engine can be reversed instantly by the valve lever on the motor. All movable parts are cushioned at their reversal, so that the engine can be run at high speed. The wearing surfaces are made ample for maximum loads, and the parts subject to steam heat are made of the best quality of steel and phosphor bronze.

The gear is equipped with an automatic stop, which is adjusted so as to close the engine valve on the engine when the quadrant or tiller has reached its furthest point of travel or hard-over point. Arrangements are made to change the gear from steam to hand power: first, by throwing out the intermediate pinion, which is held in position by lock nut shown in the cut; and, second, by releasing the valve lever and placing a pin through the hub of the steering wheel.

An indicator dial is furnished with machine, and the engine is equipped with automatic oil pump which gives perfect lubrication to the same. Sufficient length of the best quality of block chain is furnished, together with four guiding shelves, to connect the steering gear to tiller chains or cable.

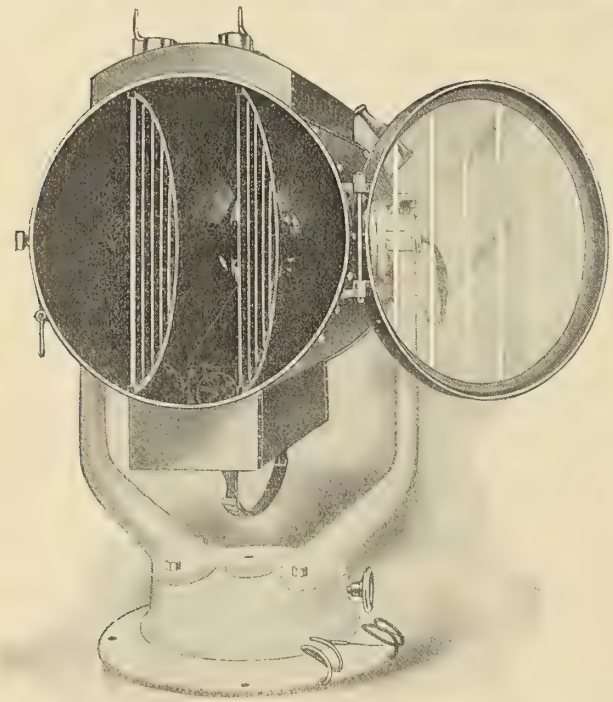
The builders claim for this machine a very simple, compact, and durable gear, occupying a small floor space, thus enabling it to be placed in small pilot houses; also a first low initial cost, the cost of same being low for this class of marine equipment. The Dake steering gear is built in two sizes or dimensions, of 5 and 8 horse-power respectively, and further particulars may be had by addressing the Holland Company, 77 Jackson Boulevard, Chicago, Ill.

Searchlight with Spreading and Converging Lenses.

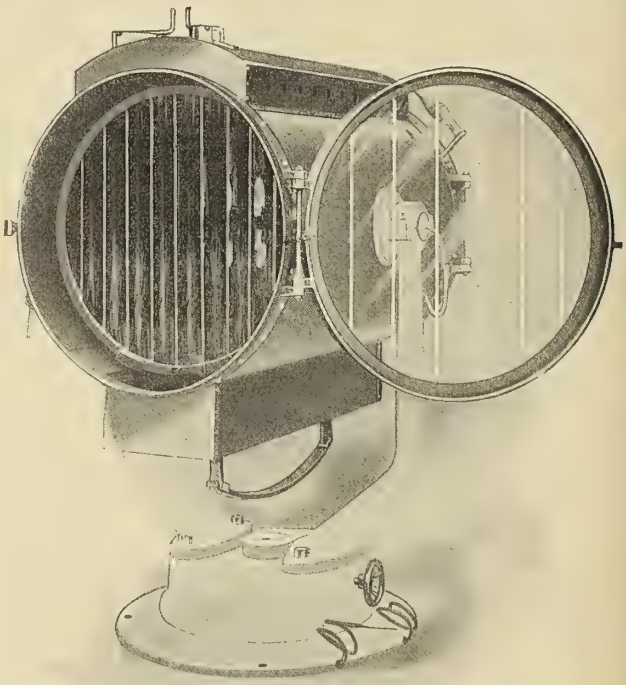
The searchlight here illustrated is fitted with a new and improved device for spreading or converging the light at will by means of dispersion lenses. Many attempts have been made before to do this, but none of them have ever attained this end in a satisfactory manner. The most common way has been to mount the dispersion lenses in a separate ring which fitted over the front of the searchlight cylinder; to put this in place, however, necessitated the removal of the door containing the plane-glass strips, and then the dispersion lenses, mounted in their own separate ring, were substituted. This was an awkward operation at best, and became a veritable nuisance on a dark and stormy night. The dispersion lenses are much more expensive than the plane-glass strips, and, when in hands not accustomed to the work, were frequently broken.

To obviate this trouble and inconvenience, the lenses

in this new design are mounted in two light brass semicircles, as shown in the first cut. These semicircles are pivoted so that they may be rotated through 90 degrees, or a quarter-circle, by two small handles on the top of the searchlight cylinder. When placed in the first position the lenses present a surface only 1-2 inch thick to the rays of light coming from the searchlight, which surface is so small that it detracts nothing from the brilliancy of the light, which emerges in a solid, straight beam. By turning the handles through an arc of a circle 90 degrees the lenses are swung around, as shown in the second cut, when all the light has now to pass through the lenses and it is spread out according to the curvature of the lenses. It requires but a moment to accomplish this result, and renders the use of the dispersion lenses so very easy that it is expected a much more extended use of them will be made in the future, now that the awkwardness of applying them, the greatest objection to them in the past, has been done away with.



CONVERGING LENSES FREE.



CONVERGING LENSES CLOSED.

A SEARCHLIGHT WITH SPREADING AND CONVERGING LENSES.

These dispersion lenses are permanently mounted in the searchlight cylinder, and trimming, cleaning, etc., are readily accomplished without removing them. The door containing the plane glass is left in position and not removed at all.

In the illustration the glass door has been purposely swung back to show the interior of the searchlight. Full particulars will be furnished by the Carlisle and Finch Company, Cincinnati, O., the makers of this searchlight.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 87 vessels of 13,579 gross tons built in the United States and officially numbered during the month of September, 1903.

QUERIES AND ANSWERS.

Q. 172.—What should be the size of a pump to deliver 8,400 gallons of water per hour, working 50 revolutions per minute? Can this problem be worked without assuming the diameter of the cylinder? C. P.

A.—The capacity of the pump depends upon the number of strokes and the displacement of the cylinder, *i.e.*, the area and the stroke. Therefore, for a given pump, these three quantities, stroke in inches, number of strokes per minute, and diameter of cylinder, must be given. In this case, as you state there are 50 revolutions per minute, we judge that the pump has a flywheel and has but one cylinder, so is not the usual form of duplex pump.

Now, solving your problem: 8,400 gallons per hour are equal to 140 gallons per minute, and at 50 revolutions, or 100 strokes, assuming the pump to be double-acting, at each stroke of the pump 1.4 gallons of water will be displaced. The United States gallon contains 231 cubic inches, therefore 1.4 gallons are equivalent to 323 cubic inches. Now let us find the properly proportioned cylinder which has this cubic capacity. It will be borne in mind that a cube contains three dimensions. The area corresponding to the diameter of 6 inches equals 28.27; dividing 323 by this figure we have roughly 11 1-2 inches. At this stroke no allowance is made for leakage or the space which the pump rod takes up on the crank end; therefore it would be well to make this stroke 12 inches at least. Now, assuming a pump with a 7-inch cylinder, the area is 38.48, and 323 divided by this gives us a stroke of about 8 3-8 inches, say 8 1-2 inches. Either one of these cylinders would fulfill the conditions of your problem.

Q. 173.—Will you kindly answer the following questions through the columns of Marine Engineering? How do you calculate the theoretical power of a steam turbine? For an impact wheel, such as the De Laval, could you use the following formula, taken from Church's "Mechanics of Engineering," page 808, with proper coefficient for losses?

$$L = \frac{G}{g}(1 - \cos \alpha)(c - v)\, v.$$

where G is weight of steam pressure per minute; c and v the velocities of steam and vanes per minute, respectively; α the angle of the exhaust steam with the initial stream of steam.

Can a formula for the power of a combination impact and reaction wheel such as Parsons turbine be reduced to anything like a rational formula?

Another question I wish to have cleared up is, wherein do the Curtis patents differ from those of Parsons and De Laval? The Curtis turbine seems to be a precise combination of the other two, with the exception of a difference of speed regulation from one and reduced speed by gearing from the other. If the Curtis turbine can be manufactured it seems as though steam-turbine patents are valueless. J. D. C. S.

A.—The theoretical power of a steam turbine cannot be readily derived by any purely rational formula such as that referred to. The chief trouble is with the fact that in the formula neither the amount of steam nor its velocity can be known from a mere statement of the dimensions and conditions of operation. It follows that neither of these factors in the equation can be ascertained without something in the nature of experimental research. Presumably the most hopeful plan for the development of an empirical formula for steam turbines would be the employment of the amount of steam and its change in thermodynamic condition in passing through the turbine, as indicated by the initial and final pressures. By experiment constants could be developed which would serve to indicate closely the quantity of steam which would, under given turbine conditions and under a given pressure, flow through a nozzle of given size; and likewise factors which would indicate the amount of heat transformed into work, as determined by the initial and final conditions of the steam. While the few turbine makers doubtless have such formulas, derived from their own experiments and suited to their own type of machine, the general engineering public has not at command a sufficient range of facts to make possible the satisfactory development of any such set of formulas, applicable to the various types of turbines now on the market. The size of turbines for given power has been thus far arrived at by each maker simply in this empirical manner and guided by his own experience.

We can scarcely, in these columns, attempt any detailed discussion of the character of patent claims. It may be noted, however, that the Curtis and Parsons turbines differ primarily from the De Laval. In the latter the steam is allowed to escape freely as a jet, and the pressure energy is thus transformed, as far as possible, into the velocity energy of a moving jet; and the energy in this form is then abstracted, as far as possible, by allowing the jet to act on a set of rotating vanes. In the Curtis and Parsons turbines this operation is broken up into a series of stages, and to some extent the development of velocity in the jet by expansion, and the abstraction of such energy by action on curved vanes, may be going on simultaneously.

Regarding further the question of patents, it may be remarked that there is and can be no patent on the fundamental turbine idea. Patents in relation to turbines can only hold on combinations of specific devices or forms for the accomplishment of the desired end. Any one can doubtless manufacture a turbine, provided he avoids the particular combinations of devices and arrangements covered by existing patents.

Q. 174.—Will you please answer the following in your Queries and Answers column?

(*a*) Will boring a hole of any diameter through a solid cylinder or shaft of any diameter increase its strength?

(*b*) If it decreases its strength, why is it that hollow shafts are so extensively used in our navy, etc.?

(*c*) Please show method and reason for obtaining the essential thickness of metal, as compared to exterior diameter.

M. F. F.

A.—*(a)* Boring an axial hole through a solid cylinder or shaft will not, of course, directly increase the strength of the shaft. On the contrary, it will decrease the strength to an extent depending on the relation between the diameter of the hole and that of the shaft.

(b) The reasons why shafts are made hollow are briefly as follows:

(1) Defects in a forged shaft are more liable to occur near the center than near the outer surface. Such defects in particular are fine cracks and a lack of homogeneity and balance of molecular condition. Now, under conditions of actual service, such cracks may extend themselves gradually from the center toward the outer surface, and into metal which at the start is free from defects of any kind. This may in time lead to the rupture of a shaft which might at first have a sufficient margin of strength. The removal of the inner core of material, with such cracks and imperfections, will remove the source of such trouble, and will leave clear, perfect, and homogeneous metal, which will remain unchanged in internal structure and condition under all normal conditions of service. Again, should there be any serious flaw in the metal of the shaft, but not quite reaching to the outer surface, the removal of the inner core will serve to indicate the presence of such a flaw, and may thus save a serious breakdown at a later time. The hole, in fact, makes possible the inspection of the metal of the shaft on two surfaces, on the outside and on the inside, and at a distance equal simply to the thickness of the metal shell left remaining. If both of these surfaces indicate the absence of all defects, it may be accepted as good evidence that the metal throughout is true to the indications and that the shaft may be depended upon. The hole, therefore, makes possible a more perfect and complete inspection of the metal, and gives a greater insurance as to the safety and general reliability of the shaft thus inspected. Again, the fraction of strength thus removed is but slight for any ordinary ratio of diameter of hole to diameter of shaft, so that no serious objection can be urged so far as the consideration of loss of strength is concerned. The loss of strength given by the inner core is readily compensated for by a small addition to the outer diameter, as referred to below.

(2) The hollow shaft, for the same strength, is lighter than the solid shaft. This is a further reason for making such members hollow, or, at least, is a further advantage which we are able to reap from such mode of treatment.

(c) The common proportion of diameter of hole to diameter of shaft is close to one-half. With this proportion the diameter of a hollow shaft needs to be only about 2 per cent. in excess of a solid shaft in order to have equal strength. More generally, the relation between the diameter of the hole, the outer diameter of the shaft, and the diameter of a solid shaft of equivalent strength is shown by the following equation:

$$S^3 = \frac{D^4 - d^4}{D}$$

where S = diameter of solid shaft, D = outer diameter of hollow shaft, d = diameter of hole.

The detailed development of this formula would not be appropriate in these columns, and it will be sufficient to note that the formula rests simply on the equality of the two moments of a solid and hollow shaft against a twisting stress. The following table shows with sufficient closeness for all practical purposes the increase of the outer diameter, in comparison with the solid shaft, in order to compensate for the removal of the metal in the hole:

Diameter of hole in proportion to diameter of shaft.	Increase in diameter of shaft in proportion to diameter of equivalent solid shaft.
.4	1 per cent.
.5	2 " "
.6	5 " "
.7	10 " "

THE DESIGN OF MARINE MACHINERY.

BY W. F. DURAND.

[9] Oval Valve Diagram.

It will be noted that in the Bilgram and Zeuner diagrams the construction consists entirely of straight lines and circles. There are still other forms of straight line and circle diagrams by means of which the movement of a valve may be represented, but the two above described will suffice for diagrams of this class. It may be noted that all such diagrams involving straight lines and circles stand on the same level as regards accuracy, and the choice between them depends simply on questions of convenience or adaptability to the special problem in hand.

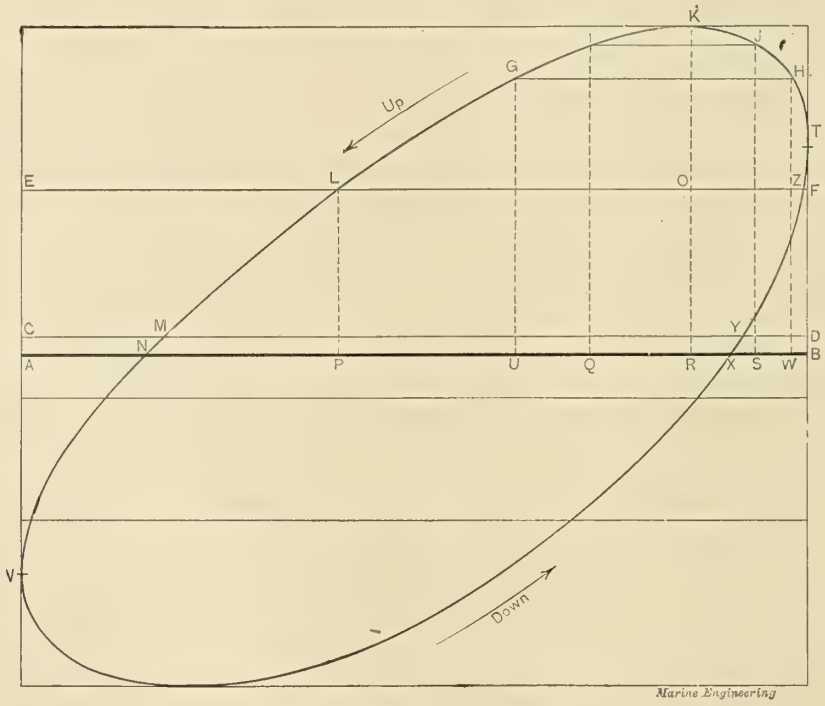


FIG. 14.—OVAL VALVE DIAGRAM.

It will be also noted that in all such diagrams the construction shows the relation between the movement of the crank and that of the valve. The movement of the piston is not directly represented, and, if the angularity of the connecting rod is to be included, can only be found by an additional construction.

For the purpose of representing the actual movement of the valve relative to the piston and including the influence of the connecting rod on the latter, a somewhat different form of diagram may be advantageously employed. Suppose we have a series of relative positions of valve and piston for an entire revolution of the crank or double stroke of the piston. Then we may represent these as shown in the diagram Fig. 14. Let AB represent to any convenient

scale the path of the piston. Then from the various points along *AB* corresponding to the positions of the piston let the distance of the valve above or below its mid-position be laid off and the points thus determined be joined by a continuous line. It is readily shown mathematically that if there were no effect due to the angularity of the connecting rod or valve rod, the resulting curve would be an ellipse. With these various effects included, however, the result is a somewhat distorted ellipse or oval, as shown in the diagram.

One side of the oval will be found to be more rounded than the other, and this will always be found on the down or in-stroke side. This difference in the curvature of the two sides may be readily traced in chief part to the effect of the connecting rod. Turning to the movement in detail, it appears that at the lower end of the stroke or piston at *B* the valve will be at a distance *BT* above its mid-position. When the piston has gone to *S* the valve will be at a distance *SJ*, at *R* a distance *RK*, and at *P* a distance *PL*. At *N* the valve will be in mid-position and will then pass below and reach a distance *AV* at the end of the stroke with piston at *A*. On the return stroke the valve will pass through a similar series of locations, determined by the distances from *AB* downward to the curve. With this arrangement of diagram the movement of the valve above mid-position is laid off above the line *AB*, and similarly for the movement below mid-position. With an outside valve this shows above the line *AB* the events for the up stroke and below the line the events for the down stroke. With an inside valve the diagram is reversed and the events for the up stroke are shown below the line and for the down stroke above the line.

We have already seen that, starting from mid-position, the valve must move a distance equal to the steam lap before the port begins to open for steam. Suppose, then, that *BF* is laid off equal to the steam lap on the lower end of the valve, and a line *FL* drawn parallel to *BA*. Then it is clear that the remaining distances from *FL* upward to the curve *ZTKL* give the distances which the edge of the valve travels beyond the first edge of the port, and hence, if the port is sufficiently wide, the actual widths of port opening. At *R* the furthest distance is reached, and the edge of the valve is at a distance *OK* beyond the first edge of the port. It is clear that the distance *RK* is the throw of the eccentric, and that this is equal to the lap plus the greatest width available for port opening. If the width of the port is equal to or greater than *OK*, then the total movement *OK* can be utilized for opening, and this will be its greatest value, while the various distances from *FL* to *ZTKGL* will give the entire history of the width of port opening for corresponding positions of the piston. Very often, however, the width of port is less than the distance *OK*. In such a case draw a line *IJ* parallel to *LF* and at a distance from it equal to the width of the port. Then it is clear that the widths of port opening will be given by the distances from *FL* to the lines *ZTJIL*. Full opening is reached at *J* or with the piston at *S*. This continues to *I*, or until the piston reaches *Q*. The port closes at *L*, or when the piston reaches *P*. This is therefore the point of cut-off or steam closure. Similarly the port opens at *Z* just before the end of the stroke, and at the end is open a distance *FT*, which therefore represents the steam lead.

Having thus obtained a general idea of the nature of this diagram, let us examine by its aid the effects of a change in the steam lap. This corresponds to raising or lowering the line *FL*, and it is readily seen that the results of an increase, for example, are as follows:

(1) Earlier cut-off.
(2) Steam opening nearer the end of stroke.
(3) Decreased lead.
(4) Decreased port opening all the way through.

The results of a decrease of lap are, of course, in the opposite direction respectively.

In a similar manner we may examine the operation on the exhaust side of the valve. This is illustrated in the same figure, where *MY* is the lap line laid off at a distance *BD* from the center line, equal to the exhaust lap on the upper end of the valve; that is, on the end which opens the port to exhaust by moving above the mid-position. It is thus seen that the valve opens to exhaust at *Y* with the piston at a distance *YD* from the end of the stroke, while at the end of the stroke it is open a distance *DT*, the exhaust lead. Then during the following stroke the distance of the exhaust edge of the valve from the corresponding edge of the port is given by the distance from *DM* to the curve *TKLM*. At *M* the port closes, and for *MC*, the remainder of the stroke, the steam undergoes compression in the cylinder. Usually the width of the port is somewhat less than the total distance available, so that the full movement of the valve cannot be utilized for actual opening. In such case draw a line *GH* parallel to *MY*, and distant from it an amount equal to the width of port. Then full opening is reached at *H* with piston at *W*, and continues to *G* with piston at *U*, the openings for the remaining portions of the stroke being given by the distance from *MD* to *YTH* and *GM*.

An increase of exhaust lap is readily seen to produce the following results:

(1) Earlier exhaust closure and longer compression.
(2) Exhaust opening or release later or nearer the end of stroke.
(3) Decreased exhaust lead.
(4) Decreased port openings or decreased time during which the port is wide open.

A decrease of exhaust lap will, of course, produce results in the opposite direction.

We have thus far been concerned with the influence of an increase or decrease in the steam or exhaust lap. It remains to examine the influence due to a change in the angle δ, the angular advance. If this angle is increased and the new series of valve movements plotted as in Fig.

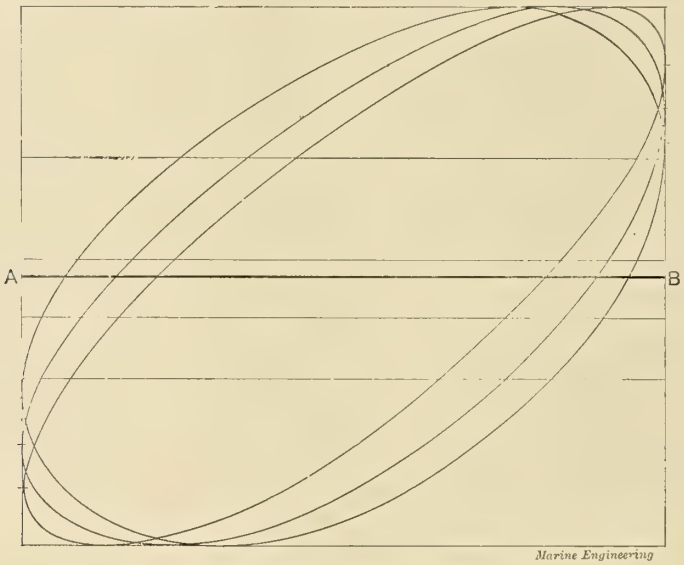


FIG. 15.—OVAL VALVE DIAGRAMS.

14, it will be found that the oval becomes narrower and touches the boundary lines nearer the corners, as shown in Fig. 15. Similarly with a smaller value of δ the valve oval will become wider or rounder, and will touch the boundary lines further from the corners, likewise as shown. Remembering this and comparing Figs. 14 and 15, it is readily seen with the same values of the lap that changes in the various quantities will take place as shown in the tabular arrangement below. This table shows at a glance the variation in the various events due to change in the three items above the double line, as explained in the foregoing.

TABLE SHOWING EFFECT OF VARIATION OF ANGULAR ADVANCE AND LAP.

Angular Advance	Increase.	Decrease.				
Steam Lap			Increase.	Decrease.		
Exhaust Lap					Increase.	Decrease.
Steam Opening	Earlier.	Later.	Later.	Earlier.		
Steam Closure	Earlier.	Later.	Earlier.	Later.		
Steam Lead	Increase.	Decrease.	Decrease.	Increase.		
Exhaust Opening	Earlier.	Later.			Later.	Earlier.
Exhaust Closure	Earlier.	Later.			Earlier.	Later.
Exhaust Lead	Increase.	Decrease.			Decrease.	Increase.
Greatest Port Opening	Same.	Same.	Decrease.	Increase.		

Attention may also be called at this point to the diagram of Fig. 16, in which the various quantities for an outside valve are lettered and named in position. A careful study of this figure in connection with the valve positions of Fig. 4 will be of great aid in acquiring a good understanding of the operation of a slide valve, and of its representation by means of such a diagram.

If the measurements for the diagram are taken from an actual engine or from a properly constructed model, it will be found, as already noted, that for the down stroke the curve is more humped or rounded than for the up stroke, as shown in the figures above. That is, for

the same relative positions of piston the valve will be further from the center line on the down than on the up stroke. This is an effect due to the angularity of the connecting rod of the engine, and it results that the various points of opening and closure, and the values of lap, lead, and port opening, cannot be made the same for both strokes. As is shown by the diagram, the cut-off is usually later on the down than on the up stroke, and it cannot be equalized without a serious derangement of the other events. Instead of attempting to equalize any two features, such as steam lead, cut-off, or port opening, it is usually better to so adjust the steam and exhaust laps above and below that the resulting combination of events shall represent the best compromise possible under the circumstances. If it were not for the effect due to the angularity of the connecting rod and valve rod, the curve would be an ellipse, and the distribution of the events for both strokes could then be made the same.

[10] Simple Eccentric Valve Gear.

We have already studied the movement of a valve due to a single eccentric, and the representation of this motion by means of various diagrams. It only remains to note a few points regarding the various combinations and arrangements in which this gear may be found.

In Fig. 17 we have the simplest and most common form, consisting of an outside valve direct-connected to the eccentric. We have already seen that, starting with the valve in mid-position, it must move a distance equal to the steam lap before the port will begin to open for steam, and hence at the end of the piston stroke the valve must have already moved from its mid-position a distance equal to the steam lap plus the lead. Suppose now that the eccentric is loose on the shaft and may be adjusted as desired. In Fig. 17 let *C* denote the crank on the center. Then suppose the eccentric first located 90 degrees ahead of *OC*, as shown at *OA*, where *OA* = *OB* = eccentric throw. Then, neglecting the slight effect due to the obliquity of the eccentric rod, the valve will be in its mid-position, as shown in Fig. 1. Next, move the eccentric ahead until the valve has moved a distance equal to the lap plus the lead, as in Figs. 2, 17. This gives the final location of the eccentric for the proper operation of the valve, as al-

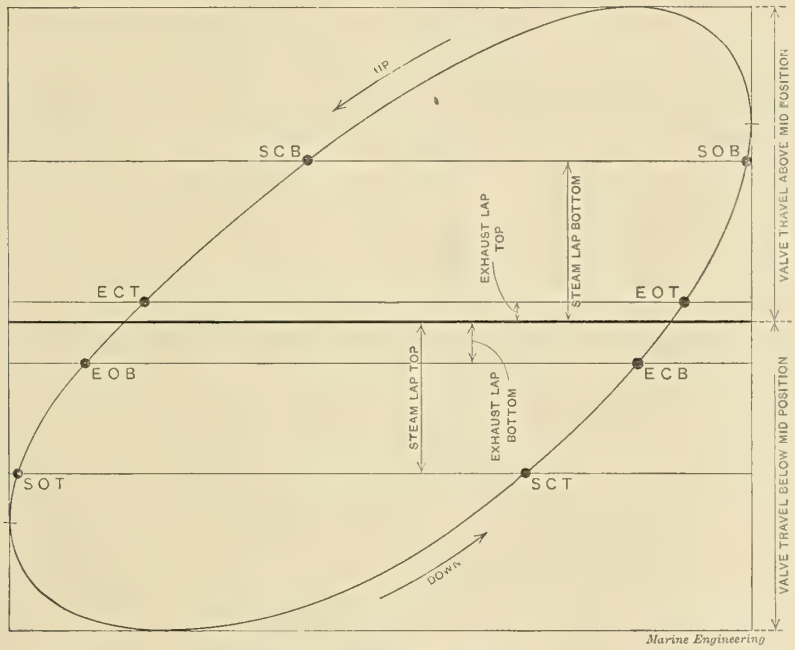


FIG. 16.—OVAL VALVE DIAGRAM.

S O B = Steam Opening Bottom.
E O T = Exhaust Opening Top.
E C B = Exhaust Closure Bottom.
S C T = Steam Closure Top.
S C B = Steam Closure Bottom.
E C T = Exhaust Closure Top.
E O B = Exhaust Opening Bottom.
S O T = Steam Opening Top.

ready described. The angle *AOB*, through which it is thus necessary to move the eccentric in order to effect this movement of the valve from its mid-position, or more exactly the angle between the eccentric and the line at right angles with the crank, we have already termed the angular advance, denoted by δ, while the entire angle between crank and eccentric is thus 90 degrees + δ.

In regard to the direction of motion of the crank, it is clear that when the piston is at the

end of the stroke and the crank on the center, the latter must start off in such direction as will increase rather than decrease the opening of the port for steam. If the connections and arrangements of a valve gear are known, no matter how complicated, this principle will always furnish an answer to the question as to the direction in which the engine will turn. Thus in a direct-connected gear, as in Fig. 17, with the piston at the end of the stroke, the crank moves in the same direction as the eccentric, or follows it, simply because that is the direction which opens the port still wider for steam admission. With an inside valve the eccentric is set at 180 degrees behind, or directly opposite the position for an outside valve, as shown in Fig. 18, or at OB_1, Fig. 17. In such case the angle between the crank and eccentric is 90 degrees $-\delta$,

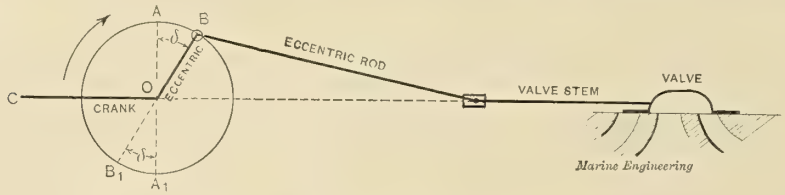


FIG. 17.—DIAGRAM SHOWING CONNECTIONS FOR SIMPLE VALVE GEAR.

or the angle δ is set off toward the crank from the 90 degree position. It is readily seen that this will bring the valve slightly open when the piston is at the end of the stroke, and that the crank will move leading the eccentric, because this is the direction which opens the port wider for steam admission. It is also seen that to fulfill the same purpose the piston and valve at the end of the stroke must move in opposite directions.

In some cases the valve rod, instead of being directly connected to the eccentric rod, is worked through a rocker arm, which reverses the motion as compared with the direct-con-

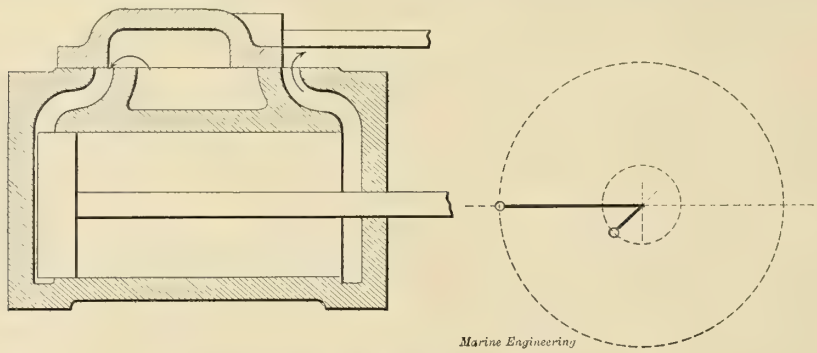


FIG. 18.—INSIDE VALVE AND LOCATION OF ECCENTRIC.

nected gear. See Fig. 19. This provides a second mode of variation which may affect the arrangement of a valve gear, giving in all four combinations, as shown in the following table:

Valve.	*Connection*	*Angle Between Crank and Eccentric.*	*Which Leads.*
Outside	Direct	$90 + \delta$	Eccentric leads
Inside	Direct	$90 - \delta$	Crank leads
Outside	Rocker	$90 - \delta$	Crank leads
Inside	Rocker	$90 + \delta$	Eccentric leads

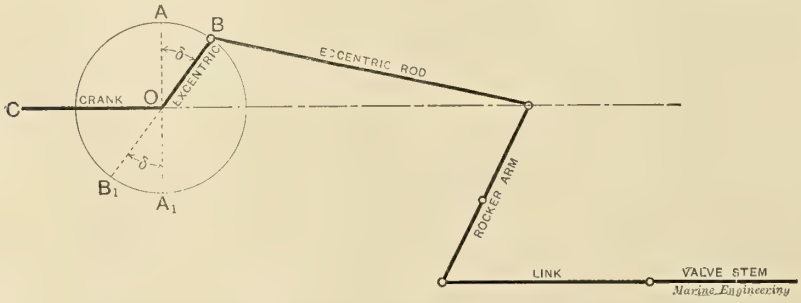


FIG. 19.—DIAGRAM FOR VALVE CONNECTIONS THROUGH A ROCKER ARM.

TECHNICAL PUBLICATIONS.

The Manufacture of Iron and Steel Tubes. Second and enlarged edition. By E. C. R. Marks. Size 5 by 7 1-2 inches. Pp. 156, with 133 figures in the text. The Technical Publishing Company, Ltd., Manchester, England. Price $1.25.

The first volume of this book comprised the development of a special course of lectures delivered in 1897 by the author during a session of the Birmingham Municipal Trade School. The second edition contains the original matter, with the needed revision regarding various patents referred to.

In addition the eighth and following chapters contain further particulars regarding the manufacture of iron and steel tubes, with reference to such British patent specifications published between the two editions as relate to the process under consideration.

An appendix is also given which, while not completely exhaustive, still contains the numbers of most of the patents which have been granted for such purposes, and should therefore be found useful to manufacturers and others as affording a ready and convenient key to the state of the art.

The subject matter of the book, together with the illustrations, is based on the printed patent specifications, and together they furnish, therefore, a comprehensive presentation of the development of the art of tube-making as indicated by the efforts of inventors in this field.

The chief feature which must be regretted in the book is the absence of more extended comment and criticism regarding the various methods and processes, and some indications regarding those which have actually proved their practical value and which have been in the past or now are in actual use, and those, on the other hand, which have not affected the actual art of tube manufacture, but have appeared only as inventors' proposals. The student of any industrial art, such as that of tube-making, is of course interested in the efforts of inventors, and in such part of the history of the art as is shown by the Patent Office records. He is still more interested, however, in those methods which have proved to be of chief industrial value, and which have left their imprint most deeply on the actual practice of the art. In a book such as the present the discrimination and criticism needed in order to give the latter information would be a matter of some delicacy and requiring much judgment and an intimate acquaintance with the practical field. Such information would, however, have added greatly to the practical value of the book to all concerned with this field of industry.

Judged from the author's purpose, the work seems to have been carefully done, and to give in condensed and yet clearly understood form a large amount of information regarding all patents of importance in this department of industrial art.

Friction and Lubrication. By Wm. M. Davis. Size 5 1-2 by 8 inches. Pp. 225, with 60 figures in the text. Lubrication Publication Company, Pittsburg, Pa. Price $2.00.

The author of this book is a practical man and has gathered together a large amount of information regarding friction and lubrication, which he presents in a well-arranged and usually clear manner. The book opens with a discussion of friction and its laws, and is followed by a large amount of information regarding friction losses in engines and in various kinds of machines, the results regarding which he has collected from various reports and scientific publications. In connection with the author's definition of rolling and sliding friction, it may be remarked that the definition of the former as the friction of a journal in a bearing, and of the latter as that of a crosshead on its guide, is hardly in accord with the accepted use of these terms. Fundamentally the friction of a journal revolving in its bearing and of a crosshead moving on its guide are the same. They are both sliding friction. Rolling friction, on the other hand, is a term used to denote the form of resistance encountered due to the rolling of a wheel or cylindrical support on a track or other like surface, and may be illustrated by the resistance due to the action at the point of contact between the wheels of a railway car and the rails.

Following the discussion of friction and the losses due to its manifestation, the author discusses briefly the general principles of lubrication. This chapter, in so far as it has to deal with fundamental principles, is hardly abreast of the latest thought on the subject. The results of relatively recent studies on the distribution of pressure in the oil film, together with the relation of such results to the general problem of lubrication, are not referred to, and such references as are made to fundamental principles are hardly satisfactory from the modern point of view. Thus the action of the lubricant is stated to be similar to that of a cushion filling up the interstices and covering up the high spots. Reference to the fundamental fact of film tension is not made, without which lubricating action would be impossible, and at the same time cohesiveness and viscosity are used as practically equivalent terms.

Following this chapter the author gives a description of the various tests to which oil may be subjected and of the machines and apparatus by means of which such tests may be carried out. This section of the book is then followed by a discussion of practical lubrication as carried out with the steam engine, with machinery of various representative types, rolling stock of railroads, etc. This is accompanied with cuts and descriptive matter relating to all manner of devices and arrangements for feeding oil or lubricant under the various conditions and for the various purposes under consideration.

The book closes with reference to bearings and journals and the properties of various bearing metals and alloys, to ball and roller bearings, to the treatment of hot bearings, and to the gauging of oil barrels and to the various points connected with the practical care of an oil house for a large industrial establishment.

The author has shown industry and generally good judgment in gathering together the matter which he presents, and to all interested in the problems of lubricants and lubrication the book will be found of interest and distinct value, especially as regards the practical points drawn largely by the author from his own experience.

Index of the Technical Press. Association de la Presse Technique, 20 Rue de la Chanselarie, Brussels. Size 9 1-4 by 4 1-8 inches. 292 pp. Issued monthly. Price $1 a year.

As the technical press which reflects the lines of thought and research of the day is so voluminous, en-

gineers and others who wish to keep posted have a difficult task before them if they are to peruse all the technical journals. The Association de la Presse Technique is publishing in concise form a monthly *Index* of all articles relative to science and technical matters appearing in the technical papers throughout the world. The *Index* is printed in three languages, namely, English, French, and German. For the résumé of those journals published in languages of Latin origin and in Russian the French language is employed; Scandinavian and Dutch journals are indexed in German.

The *Index* gives the author's name, the name of the article and the volume in which it is published, and its length, also classification number according to the universal classification system of Brussels. Thus one may read the names of all articles appearing in the branches in which he is especially interested, and, if he so desires, obtain from the Association the desired copies of the articles translated in any language at a small cost. If these indices are pasted on cabinet filing cards, which so many individuals and companies are using to-day, they form a ready and valuable reference. This will be found to be a very valuable asset to the busy professional man's library.

Manning's Yacht Register, 1903. Manning's Yacht Agency, 45 Broadway, New York, N. Y. Size 10 by 7 3-4 inches. In two parts. Part I. 248 pp., Part II. 304 pp. Price $10.

The new edition of Manning's Yacht Register, for the present year, presents a very attractive form bound in white duck. The issue is in two volumes, the first of which contains a complete register of the recognized yacht clubs throughout the United States and British provinces, and also the Royal Jamaica and Argentine Yacht Clubs; full lists of officers of the yacht clubs, names of yachts, official numbers, signal letters, dimensions, by whom built, designed, and owned; and general dimensions and particulars of all sail and steam yachts. Then follows a list of yachts the names of which have been changed and the yacht owners. The first volume is very fully illustrated with fac-similes in colors of club flags and private signals of owners. Part II. contains a report regarding the yacht club regattas and races for 1902, compiled from official sources, showing names of yachts, racing lengths, time allowance, rules of the different clubs, weather in which the race was sailed; also course distances, the number of trials in each case, times of starting and finishing, together with elapsed and corrected times and results, and in fact all particulars about the races. Reports are also compiled of the America's, Cape May, and Brenton's Reef Challenge Cups. In fact these books contain full reports of American yachts and yachting.

The Art of Pattern-Making. By I. McKim Chase. Size 5 inches by 7 1-2 inches. Pp. 251, with 215 figures in the text. John Wiley and Sons, New York. Price $2.50.

The subject matter of this book is taken largely from the personal experience of the author with the art of pattern-making in its various branches, supplemented by the experience of others in various special parts of the field. The contents include chapters on the equipment and management of a modern pattern shop, followed by a wide range of typical and special illustrations of patterns met with in various fields of engineering work, and for molding in loam and sand both dry and green. Among these may be mentioned: the steam cylinder of a marine engine, screw propellers in loam and in sand, both with solid and separable blades, belt pulleys and flywheels, gear teeth, gun-mount pedestal, etc. These are followed by chapters on various special matters of interest and importance to the pattern maker, such as: the use of a wood lathe; how to make a wooden face plate; making, recording, and storing patterns; making special shrinkage rules; wax fillets; together with various rules for computation, geometrical constructions used in drawing, standard conventions for section lining, etc.

The book is written in a plain and simple style and the explanations are in general quite clear. Here and there carelessness in the letters referring to drawings is noticeable, but as a rule the meaning is clear.

The literature relating to pattern-making is not large, and this contribution, from one whose active life has been so largely spent in immediate contact with such work, should prove of distinct value to all practical workers in this field.

1903 Blue Book of American Shipping. By the Marine Review Publishing Company, Cleveland, Ohio. One volume of 468 pp., 10 by 7 inches. Price $5.

The value to the business man of correct lists of individuals and companies in his special line is well recognized. This year's volume of the Blue Book forms a most worthy reference book on marine subjects. It contains names of officers and individuals of all maritime trades, such as naval architects, marine superintendents, marine engineers, shipowners, shipchandlers, shipmasters, etc. Especially does this book cover the industry of the Great Lakes. Much valuable information is given concerning lake shipping. There is also a list of all the American steam and sailing vessels of the Great Lakes. Valuable tables are compiled concerning the trade on these great inland waters, such as the iron ore carried from the different districts, railway facilities, transportation rates, movement of grain, etc. A complete list is given of the dry-docks, marine railways, shipbuilders, and steamship companies throughout the country, also names and addresses of the yacht owners of the United States, yacht clubs and admiralty lawyers. The book is printed on heavy coated paper and is illustrated with engravings of many of the new types of vessels.

The Drafting of Cams. By Louis Rouillion. Size 6 1-2 by 8 inches. Pp. 24. Paper bound. The Derry-Collard Company, 256 Broadway, New York, N. Y. Price 25 cents.

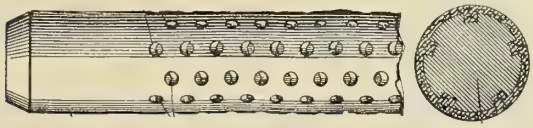
This is the second in a series of practical papers published by the company relating to machine design. Each one of the series is written by a practical man and is intended to meet the wants of draftsmen or machinists wishing to learn the essential way of laying out cams. The use of the cam is first described, then the method of laying out the different forms, well illustrated with clear cuts. The treatise is divided under the two heads of cams where the line of action is central and where it is not central. The paper is completed by illustrating a problem in designing a belt shifter. The method in which the books of this company are sold permits one to first examine the book before paying for same. If it does not meet with approval it may be returned.

SELECTED MARINE PATENTS.

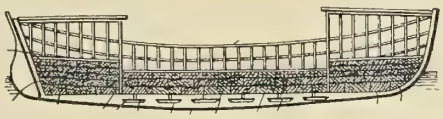
736,891. MEANS FOR PROTECTING SUBMERGED DEVICES. OMAR A. STEMPEL, LAKELAND, FLA., ASSIGNOR OF ONE-HALF TO CHARLES M. MARSH, LAKELAND, FLA.

Claim.—1. An object adapted to be submerged in water, having series of individually-formed key seats with inclined walls, the walls of alternate series being inclined in reverse direction, and a covering applied over the object and forced into the said seats.

2. An object adapted to be submerged, having series of individually-formed key seats therein, a coating of protective paint applied over the object and run into the seats, and a covering applied over the object on the coating of protective paint and forced into the seats. Two claims.

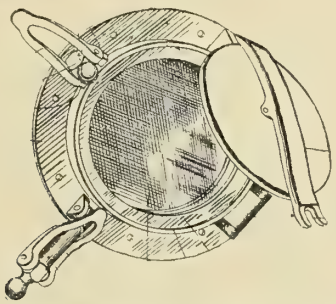


736,747. LIFEBOAT. AUGUSTO LASERRE, BUENOS AIRES, ARGENTINA.



Claim.—A lifeboat having its bottom provided with a vertical drain channel disposed between longitudinally-ranging tanks, and a weighted metallic keel depending from the bottom of the boat and disposed in the vertical plane of the drain channel therein, said weighted keel being provided with vertical and transverse slots which communicate with each other and also have communication with the drain channel. One claim.

736,772. PORT LIGHT. CHRISTIAN F. PETERSEN, WILMINGTON, DEL.



Claim.—1. The combination of a main or body portion having a port opening and a packing gasket surrounding the same, a glass and glass frame, the latter being arranged to bear on said gasket, means for holding the glass frame in position, substantially as described, the said glass frame comprising two rings screwed together with an internal packing gasket fitting between them, said rings having inwardly-extending flanges embracing the top and bottom sides of the glass.

2. A port-hole cover comprising a cover proper of concavo-convex cross-sectional form, a swinging arm connected with the central portion of the cover, a link formed of adjustable sections, and a cam lever mounted on the link and adapted to engage the free end of the arm. Eight claims.

736,428. SOUND-PRODUCING DEVICE SUITABLE FOR SIRENS OR LIKE INSTRUMENTS. JOHN P. NORTHEY, TORONTO, CANADA. Four claims.

738,190. MEANS FOR GUIDING BOATS PROPELLED BY ELECTRIC OR OTHER POWER. HENRY HEALY, BUFFALO, N. Y.

Claim.—1. In an electric system of canal propulsion, the combination with a waterway and a boat, of a series of trolley poles located along the line of the waterway for supporting a feed wire, guide rails arranged upon opposite sides of the trolley poles beneath the feed wire, an arm secured to the side of the boat, means carried by said arm for engagement and travel upon the guide rail, and electrical communication between the boat and the feed wire.

2. In a system of canal propulsion, the combination with a waterway and a boat, a guide rail, a plate slidably and adjustably mounted upon one side of the boat, said plate having an offset projection, an arm hingedly connected to said projection, and means carried by the free end of the arm for engagement and travel upon the guide rail. Three claims.

738,206. SEMI-SUBMERGIBLE VESSEL. SIMON LAKE, BRIDGEPORT, CONN.

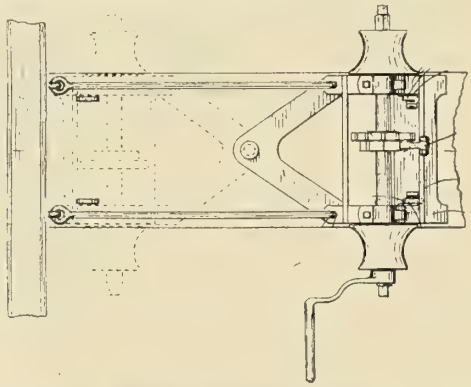
Claim.—1. A vessel having one end constructed and adapted to float permanently at the surface of the water and the opposite end normally buoyant, but provided with means whereby it may be caused to sink beneath the surface.

4. A vessel having one end adapted and constructed to be maintained permanently at the surface of the water and provided at or near the other end with a diver's compartment having doors communicating, respectively, with the exterior and interior of said vessel, an adjacent water-ballast compartment, and means whereby water may be admitted to or expelled from said water-ballast compartment. Five claims.

738,221. SHIP'S-COURSE RECORDER. WILLIAM MAXTED, WERNERSVILLE, PA.

Claim.—1. A ship's-course recorder comprising a compass box, a stationary card arranged within the compass box, and a vertically-movable compass card carrying a marking device adapted to record the course of the ship upon the card, as specified. Five claims.

738,348. WINCH FOR FISH BOATS. JOHN J. McDONALD, PORT MADISON, WASH.



Claim.—1. An apparatus of the class described, comprising, in combination, a frame having end standards and a base plate, a shaft journaled in said frame ends and carrying spools and a gear wheel, another shaft journaled in said frame ends and having a pinion mounted thereon which meshes with the said gear wheel, a trunnion extending through the said base plate and pivotally connecting the frame to a supporting platform or boat-thwart, staples connected with said thwart and adapted to engage with the same frame, locking keys for said staples, and the stay rods. Two claims.

738,359. BOAT. GRENVILLE H. ROOD, WASHINGTON, D. C. Twelve claims.

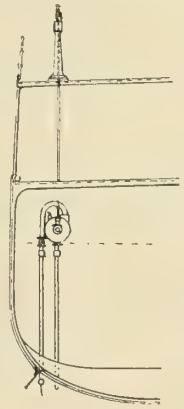
738,400. DETACHABLE LIFERAFT FOR SHIPS. BENJAMIN W. BOOKER, BERKELEY, CAL.

Claim.—1. The combination with the hull of a vessel of a detachable life-saving superstructure; guides on the vessel between which said structure is supported; collars or caps secured to the under side of the deck of the vessel, and projections on the bottom of the superstructure fitting said collars or caps, said collars or caps and projections perforated coincidently; locking pins engaging said collars or caps, and projections and means whereby the pins are actuated in unison to release the parts. Three claims.

738,436. WATER VEHICLE. HENRY A. HANSEN, NEW YORK, N. Y., ASSIGNOR OF ONE-HALF TO PAUL OLSEN, NEW YORK, N. Y.

Claim.—1. A water vehicle comprising a main frame, a propeller float mounted longitudinally in the bottom thereof and provided with a shaft, said propeller float being circular in cross section and pointed at the front end, and provided with a spirally-arranged propeller, devices for turning the propeller float, a support at the front of the main frame, a rod passing vertically therethrough, a steering float connected with the lower end of said rod, a handle bar connected with the main frame, and devices whereby said handle bar is put in operative connection with the steering float. Three claims.

738,458. APPARATUS FOR INDICATING SPEED OF



VESSELS. SIDNEY J. LAWRENCE, CHRISTCHURCH, NEW ZEALAND.

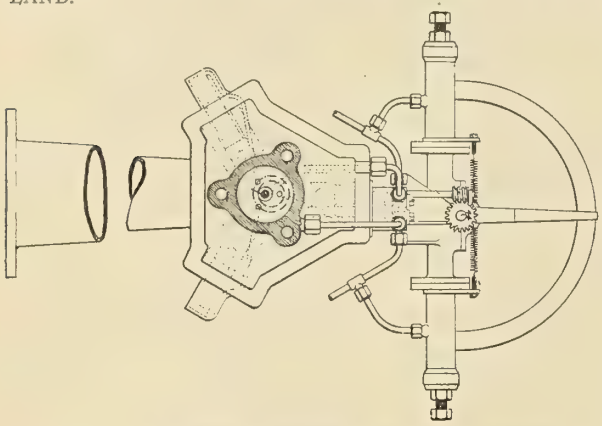
Claim.—1. The combination in apparatus for the purpose indicated of a turbine motor, a pipe communicating with the inlet port of said motor extending through the hull, and having a bend projecting toward the bow of the vessel, a pipe communicating with the exhaust port of said motor and extending through the hull of the vessel, a bevel wheel upon the spindle of said motor gearing with a bevel pinion upon a vertical spindle extending up through the deck of the vessel, and means for actuating indicating gear by the revolution of said vertical spindle. Three claims.

738,595. MOORING DERRICK SCOWS IN RAFT CONSTRUCTION. JOHN AYRES, PORTLAND, ORE., ASSIGNOR TO OREGON RAFTING COMPANY, PORTLAND, ORE., A CORPORATION OF OREGON. One claim.

738,695. BOW-FACING OAR. ELI S. McCAULLEY, MONTOUR, IOWA, ASSIGNOR OF ONE-HALF TO THOMAS U. FRANTZ, MONTOUR, IOWA. Three claims.

738,725. SYSTEM OF SUBMARINE COMMUNICATION. SIMON LAKE, BRIDGEPORT, CONN. Five claims.

738,767. TELEMOTOR APPARATUS FOR SHIPS OR THE LIKE. ANDREW B. BROWN, EDINBURGH, SCOTLAND.



Claim.—1. A telemotor apparatus comprising a hydraulic cylinder and piston, and pipes leading thereto, in combination with mechanism for forcing fluid through said pipes, consisting of three single-acting pumps and a distribution valve connected therewith, a hand-wheel shaft and parts for operating such pumps and valve therefrom, two cylinders, a spring-controlled plunger in such cylinders, two pointers, gearing connecting the plunger with one pointer and the second with the hand-wheel shaft, a clutch connected with the second pointer, with means for putting it into and out of gear on the movement of the first pointer, and pipe connections leading to the hydraulic cylinder and also to the plunger cylinders substantially as described. Three claims.

738,879. AUTOMATIC DIVING MECHANISM FOR SUBMARINE BOATS. FRANCIS W. BRADY, ENGLEWOOD, N. J., ASSIGNOR TO ELECTRIC BOAT COMPANY, NEW YORK, N. Y., A CORPORATION OF NEW JERSEY. Four claims.

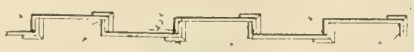
738,985. PROPELLER. EDUARDO CLAUDIO, RIO JANEIRO, BRAZIL. Two claims.

738,996. WAVE MOTOR. FERDINAND J. HAGEN, NEW YORK, N. Y. Five claims.

739,033. SHIP LOADING OR COALING DEVICE. JULIUS TARR, PHILADELPHIA, PA.

Claim.—1. In a device of the character described, a boom pivoted to the deck of the vessel, guy ropes for adjusting and securing the boom in place, a cable secured at one end to another vessel or to the land, this end being secured at a point lower than the upper end of the boom, said cable passing over a roller journaled in the upper end of the boom and also over a roller secured to the mast of the vessel, a weight suspended upon this end of the cable, a traveler designed to travel along said cable, a cable secured to said traveler, a bucket or other receptacle suspended from said cable, said cable passing from the traveler over a pulley upon the boom downward to a winding apparatus, means for releasing the bucket so as to allow the same to descend when it has reached its destination. Two claims.

739,072. SHEET PILING. LUTHER P. FRIESTEDT, CHICAGO, ILL.

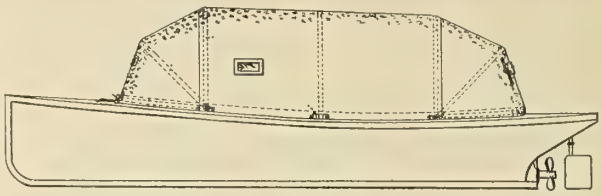


Claim.—1. A metal sheet piling, comprising beam sections joined edgewise and carrying means for transmitting a retaining pressure from the earth walls as the sections are forced into place. Six claims.

739,302. BOW-FACING OAR. JOSEPH P. FRETWELL AND JAMES T. BROWN, PENASOFFKEE, FLA. One claim.

739,389. STORM HOOD AND COVER FOR LAUNCHES. ARTHUR H. CASTLE, MINNEAPOLIS, MINN., ASSIGNOR OF ONE-HALF TO S. M. HAUSER, MINNEAPOLIS, MINN.

Claim.—1. The combination, with a launch deck and coaming, of a plurality of ribs or bows curved to conform substantially to the curve of the coaming at the end of the cockpit and adapted to drop down upon the deck outside of said coaming, the ends of said bows being pivotally secured, a flexible material covering and connecting said bows, means for securing one of said bows at a point intermediate to its ends in a horizontal position on the deck, and means for supporting the other bows in a raised position and drawing said covering taut between them and said horizontal bow. Four claims.



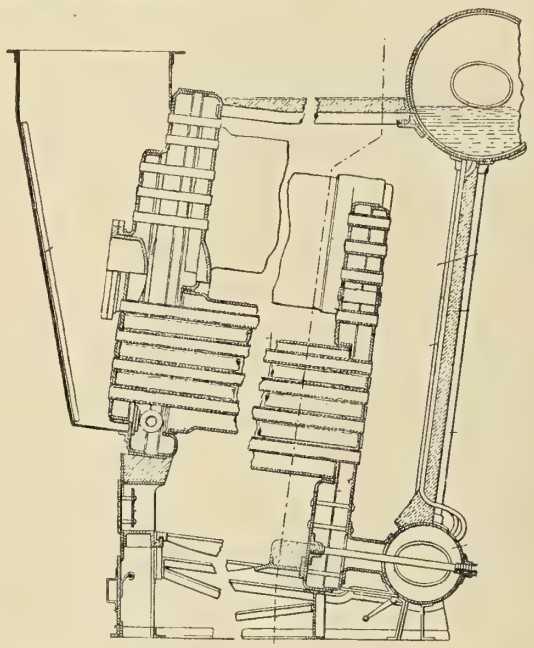
739,475. RANGE FINDER OR TELEMETER. ARCHIBALD BARR, GLASGOW, SCOTLAND, and WILLIAM STROUD, LEEDS, ENGLAND. Three claims.

739,734. SUBMARINE BOAT. LAWRENCE Y. SPEAR, GREENPORT, N. Y., ASSIGNOR TO ELECTRIC BOAT COMPANY, A CORPORATION OF NEW JERSEY. Six claims.

739,735. COMPENSATING DEVICE FOR SUBMARINE OR SUBMERGIBLE BOATS. LAWRENCE Y. SPEAR, GREENPORT, N. Y., ASSIGNOR TO ELECTRIC BOAT COMPANY, A CORPORATION OF NEW JERSEY. Five claims.

739,775. BOAT OR VESSEL. HYRAM J. BAYARD, CHICAGO, ILL. Four claims.

740,270. MARINE BOILER. PAUL GRÜNEWALD, DUISBURG, GERMANY.



Claim.—1. A boiler comprising front and rear transversely-extending water chambers, large longitudinal water tubes connecting the chambers with each other at their inner adjacent faces, smoke-return flues extending longitudinally through the said water tubes and through the outer faces of the water chambers, and short smoke flues extending longitudinally through each of the water chambers.

2. A boiler, comprising front and rear transversely-extending water chambers, large longitudinal water tubes connecting the said chambers with each other, smoke-return flues extending longitudinally through the water tubes and through the outer faces of the water chambers, a transverse mud drum in the rear of the rear water chamber and connected with the lower end thereof, a transversely-extending steam drum in the upper part of the boiler, stand pipes supporting the steam drum and connecting it with the mud drum, and pipes connecting the mud and steam drums and forming the rear wall of the boiler. Six claims.

740,317. MARINE TORCH. WILLIAM H. ROSE, BALTIMORE, MD., and JAMES A. WATSON, WASHINGTON, D. C., ASSIGNORS TO THE MARINE TORCH COMPANY OF BALTIMORE CITY, BALTIMORE, MD. Seven claims.